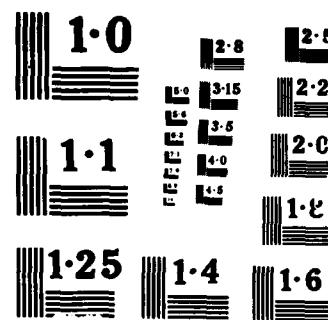


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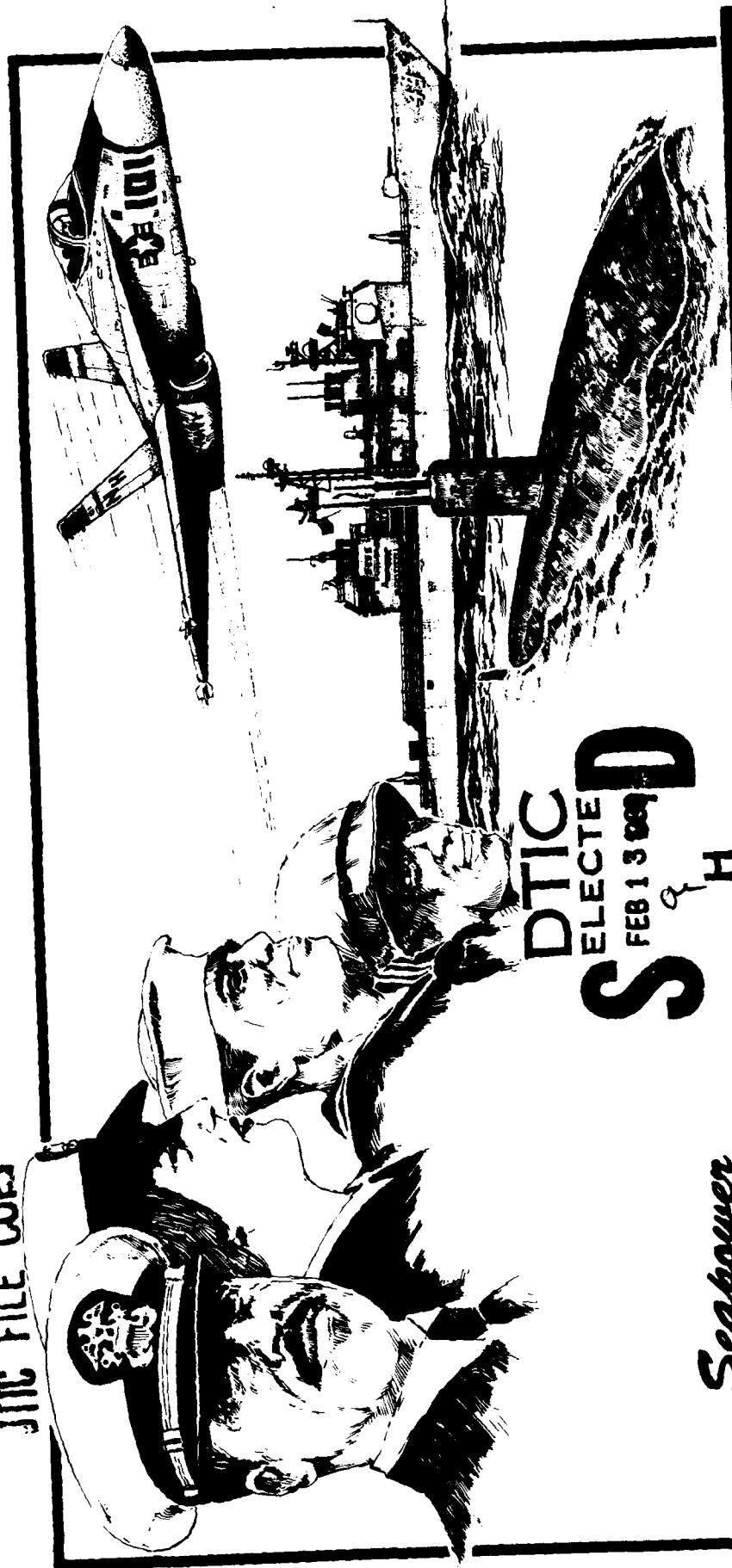


Navy Personnel Research and Development Center

San Diego, CA 92132-0000 AP 88-1 October 1988

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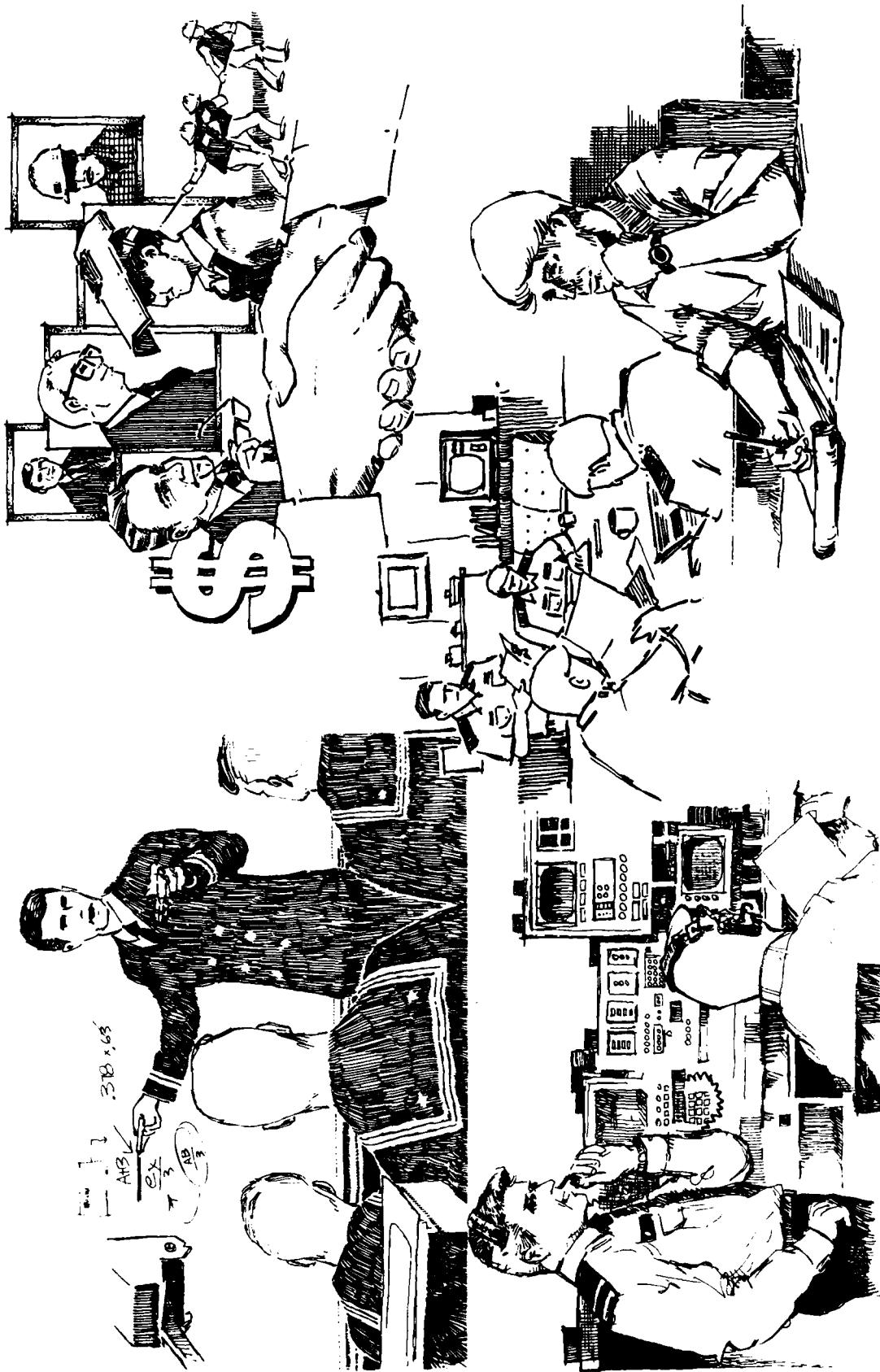
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PROJECT
PROFILES



Navy Personnel Research and Development Center
San Diego, California 92152-6800
October 1988

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Project Profiles is prepared as a reference source for information about the kinds of work currently being conducted at the Navy Personnel Research and Development Center (NPRDC).

In order to fulfill our mission, we are presently conducting over 100 in-house research and development projects. Brief descriptions of selected efforts are contained in this publication. Projects on Independent Research/Independent Exploratory Development (I/R/ED) work are reported in the I/R/ED Annual Report. In addition to familiarizing the reader with the Center's work, it is our hope that these project descriptions will lead to an interchange of information between interested readers and project personnel. Please feel free to contact either of us, or any member of the staff, to discuss our efforts or to obtain additional information.

NPRDC is interested in receiving employment applications from persons with education or experience in a wide range of disciplines. Experimental and cognitive psychology, personnel selection and training, management science, operations research, economics, statistics, computer science, mathematics, and engineering psychology are professions represented at the Center. As an equal opportunity employer, NPRDC welcomes applications from minorities and women.

We are looking for talented people who want to put their expertise to work solving challenging problems. If you are looking for a rewarding career and want to work in a creative environment, NPRDC may be the place for you. We would like to hear from you.

J. S. McMICHAEL
Technical Director

B. E. BACON
Captain, U.S. Navy
Commanding Officer

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QUALITY
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Some Background on the Commanding Officer and the Technical Director

Captain Barton E. Bacon III assumed his present duties as Commanding Officer, NPRDC in June 1986.

Captain Bacon graduated from the University of Washington, Seattle, in 1959 and entered the Navy as an Aviation Officer Candidate at Pensacola, Florida. He was commissioned an Ensign in 1960.

Following a tour aboard USS *YORKTOWN* (CVS 10), Captain Bacon attended submarine school and subsequently served aboard five San Diego-based submarines: USS *REDFISH* (SS 395), USS *VOLADOR* (SS 490), USS *SEGUNDO* (SS 398), USS *Salmon* (SS 593) (as Executive Officer), and USS *TROUT* (SS 566) (as Commanding Officer). Under his command, *TROUT* was the only fast-attack diesel-electric submarine selected from both the Pacific and Atlantic Fleets for the Battle Efficiency E award.

Captain Bacon served on the staffs of Commander Submarine Squadron 3, Commander Submarine Group 5, Commandant Thirteenth Naval District, Chief of Naval Personnel, and Chief of Naval Operations. During his Washington tours, he served as the Enlisted Rating Coordinator for submarines while assigned to the Bureau of Naval Personnel and as the Primary Action Officer in the Joint Chiefs of Staff arena for development of

Joint Strategic Planning Documents while assigned to OPNAV Plans and Policy Office (OP-06).

After serving as Commanding Officer, Submarine Training Facility, San Diego, from 1980 to 1983, Captain Bacon was assigned as Commanding Officer of the amphibious ship USS *CLEVELAND* (LPD 7). While under his command, *CLEVELAND* was nominated for the Arleigh Burke Award, representing the most improved ship in the Pacific Fleet.

Captain Bacon is a graduate of the National War College of the National Defense University, the Armed Forces Staff College, Defense Intelligence College, and the Senior Officer Material Readiness School.

Captain Bacon comes from a submarine family. His father, RADM Barton E. Bacon II, USN (Ret) (deceased), commanded the submarine USS *PICKEREL* (SS 524) through five war patrols during World War II. His twin brother, VADM Roger Bacon, USN, is currently assigned as Commander, Submarine Force, U. S. Atlantic Fleet, Norfolk, Virginia, and his younger brother, Commander Dan Bacon, USN (Ret), served for 20 years in the submarine force. At one period during their respective careers, each brother was in command of a Pacific Fleet submarine.

Dr. James S. McMichael was born in Pittsburgh, Pennsylvania. He graduated from Princeton University in 1961 and received his Ph.D. from the University of Delaware. In 1982 and 83, he was a fellow in Princeton University's Woodrow Wilson School of Public and International Affairs where he concentrated in economics, management, and international policy.

Dr. McMichael has been the Technical Director at NPRDC since March 1987.

He entered the Senior Executive Service in October of 1984 as Director of the Training Laboratory at NPrDC, where he had managed personnel research since 1975. His research specialty is military training. As Laboratory Director he directed research in areas such as intelligent systems for training, team training, training management, curriculum models, production and quality control, Naval career models, Marine Corps training, and low-cost simulation.

From August 1986 to August, 1986, Dr. McMichael served as Special Advisor for Manpower, Personnel, and Training in the Directorate of Research, Development, and Acquisition (OP-098) and to the Deputy Assistant Secretary of the Navy (Manpower). He had responsibility for advanced-development and engineering development of systems for manpower, personnel and training, for scientific advice on manpower matters to the Director, and for policy matters regarding research and development.

Prior to joining NPrDC as a research scientist, Dr. McMichael chaired the Department of Psychology of Long Island University, where he taught for ten years. A resident of San Diego, Dr. McMichael is married to the former Ellen Keppler. They have two sons: Andrew and Daniel.

Introduction to NPRDC

The Navy Personnel Research and Development Center (NPRDC) is the Navy's principal activity for the development of people-related technology.

Our field of endeavor includes the areas of

- manpower
- personnel
- testing systems
- education and training
- organizational systems

which cover many of the most complex and far-reaching questions that confront the Navy today.

Project efforts at the Center vary greatly in their focus, ranging from the

- systems level down to
 - the level of the individual, and from
 - immediate problems to the
 - problems the Navy will face in 25 years.

Center products take diverse forms:

- computer models of many Navy functions
- curriculum and training methods
- critical information that policy makers, administrators, and managers must have in order to carry out their work effectively.

The professional staff of the Center, representing a variety of disciplines (statistics, mathematics, operations research, economics, computer science, personnel and organizational psychology, and instructional technology), is composed of

- civilian scientists and technicians
- senior Navy personnel with extensive fleet experience.

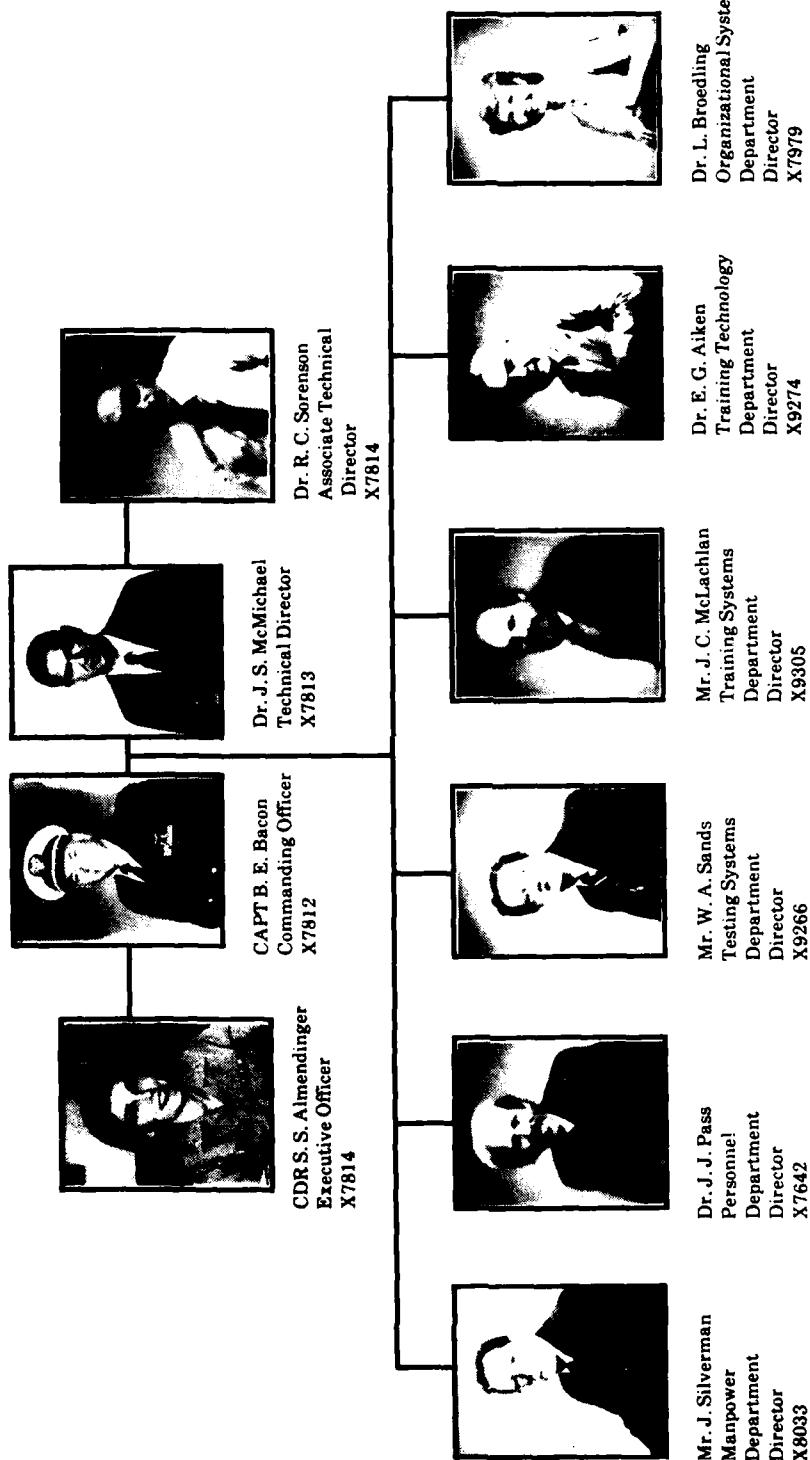
The Center's research and development program represents a comprehensive and effective system for developing the technology needed to

- improve personnel programs
- design more effective and less costly training programs
- optimize personnel management planning and compensation
- increase productivity
 - improve morale
 - reduce attrition.

NPRDC is organized into six research departments shown on the following page.

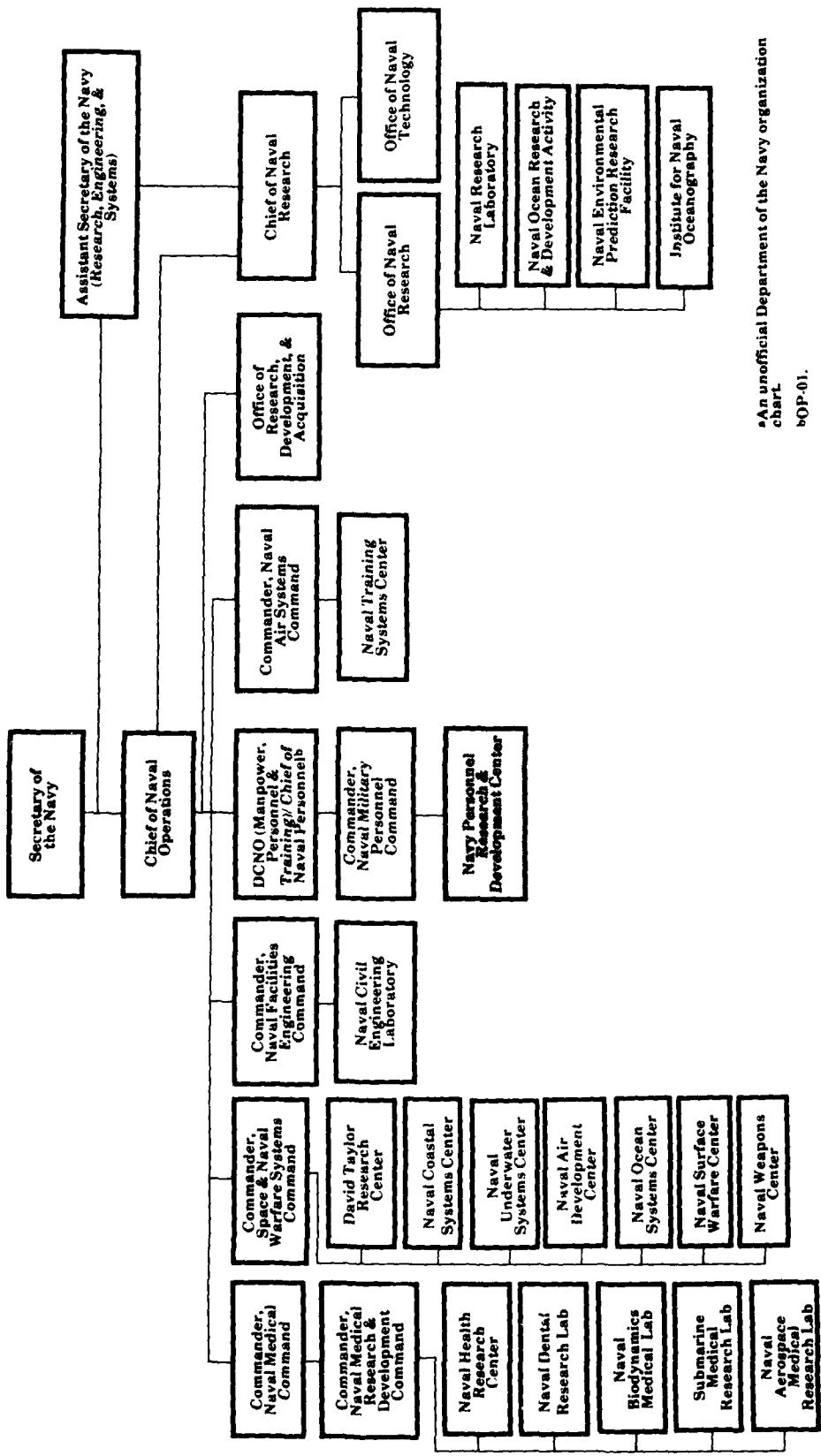
NPRDC's reporting relationships within the Department of the Navy are shown on page 5.

NPRDC Organization



To reach NPRDC, dial (619) 553 plus the 4-digit extension indicated above. If you are calling on Autovon, the prefix is 553.

**Department of the Navy Research, Development, Testing, & Evaluation (RDT&E) Organizations
(NPRDC Reporting Relationships)**



*An unofficial Department of the Navy organization chart
bOP-01.

History

NPRDC was established in May 1973. This action resulted from the consolidation of human resources R&D functions previously performed by the Naval Personnel Research and Development Laboratory, Washington, D.C., Naval Personnel and Training Research Laboratory, San Diego, and the Personnel Research Division, Bureau of Naval Personnel. The Center was placed under the Bureau of Naval Personnel. Management control shifted to the Chief of Naval Material in May 1975, to the Chief of Naval Research in May 1985, to the Commander, Space and Naval Warfare Systems Command in February 1986, and to the Commander, Naval Military Personnel Command (NMPC) in May 1988.

Mission

The Chief of Naval Operations has assigned NPRDC the following mission:

To be the principal Research and Development Center for the Department of the Navy's planning and utilization of manpower and personnel and to pursue a coordinated technical development program in the areas of education and training.

It is Center policy to only perform work that falls within the assigned mission, addresses high-priority Navy and Marine Corps requirements, and represents the most efficient use of available resources. We are determined to assist our sponsors, claimants, and customers in identifying and prioritizing requirements for manpower, personnel, and training (MPT) research and development.

Functions

In fulfilling the mission stated above, the Center performs the following functions assigned by the Commander, NMPC:

1. Plans and develops effective MPT products for Navy/Marine Corps operational application. Provides technical assistance to support the transition and implementation of Center products.
2. Develops and maintains in-house Navy/Marine Corps scientific and technical expertise to provide corporate knowledge, corporate memory, technological innovation, "smart buyer" assistance, and real-world understanding necessary for the development and support of Navy/Marine Corps MPT.
3. Plans and conducts an effective technology base program (basic research, exploratory development, and advanced technology demonstrations) to meet existing and projected operational requirements and to maintain scientific and technical leadership in MPT areas.
4. Develops new systems and methods for determining manpower requirements, allocating manpower resources, developing personnel inventories, and redistributing/assigning those inventories to improve military readiness and control costs.
5. Develops systems and procedures for recruiting, selecting, classifying, and utilizing officer, enlisted, and civilian personnel to improve performance and retention. Serves as the Chief of Naval Operations' primary personnel survey resource to coordinate and conduct attitude surveys in the Navy and Marine Corps and to develop new survey technology.

TR 6

6. Develops and evaluates personnel testing systems and computerized adaptive testing (CAT) versions of the Armed Services Vocational Aptitude Battery. Serves as lead Department of Defense laboratory for overall management of CAT research, development, implementation, and scientific support of the system.
7. Develops training technologies to enhance personnel readiness.
 8. Employs existing and emerging technologies in the development and application of training systems to alleviate Navy training problems and improve the Navy's operational readiness.
 9. Develops and evaluates performance enhancement and control systems for improving the effectiveness, quality, and productivity of Navy personnel and organizations.
 10. Develops, evaluates, and applies innovative personnel assessment technology.
11. Provides the Marine Corps with research and development support in MPT and organizational systems.
12. Provides independent analyses, technical advice, and consultation to research, development, test, and evaluation (RDT&E) and operational managers in matters related to the Center's mission.
13. Investigates, defines, and addresses operational problems related to fleet personnel performance.
14. Maintains a field office in Washington, D. C. for the purpose of conducting on-site projects.

15. Develops, installs, and provides life cycle support for information management systems.
16. Provides information and reports to higher authority and the scientific community on the progress and accomplishments of the Center's programs.
17. Provides technical support in the development of the BUPERS/NAVMILPERSCOM long range plan with regard to the infusion of appropriate technology, definition and prioritization of RDT&E requirements, and the transition of products into operational use.
18. Provides information and technical support to the Center's BUPERS/NAVMILPERSCOM Program Manager in all matters related to the Center's operation.
19. Develops and maintains liaison with Navy, Department of Defense, and civilian RDT&E organizations for the exchange of information and the establishment of cooperative efforts in MPT areas.

Operating Philosophy

NPRDC is an applied research center, contributing to the personnel readiness of the Navy and Marine Corps. The Center develops better ways to attract qualified people to the naval services, to select the best, to assign them where they are most needed, to train each one effectively and efficiently, and to manage our personnel resources optimally. By combining a deep understanding of operational requirements with first-rate scientific and technical abilities, the Center is unique in being able both to develop new, useful knowledge and to refine technology to address people-related issues. This dual expertise permits the Center to develop the technology base for

improving the use of human resources within Navy systems and to apply state-of-the-art technology to solve emerging problems. As a corporate asset, NPRDC is responsive to the needs of MPT managers in the Navy, Marine Corps, and DoD, to the operating forces and to the shore establishment that trains and supports the Fleet.

The R&D methods used by NPRDC are derived from behavioral, cognitive, computer, economic, and social sciences as well as from applied mathematics and statistics. The application of these methods results in tangible products of use to the Navy and Marine Corps. NPRDC constantly searches for technological opportunities to improve personnel readiness and to reduce manpower costs. We are accountable to Commander, Naval Military Personnel Command, our sponsors, and our users for high productivity, strict ethics, honesty, integrity, professionalism, and perspective.

As part of its operating philosophy, NPRDC seeks to do as much of its work as possible in the operational setting where the final products of the effort are intended to be used. This helps to ensure that the needs and requirements of the users are met and that the users themselves become familiar with the operational capabilities of the particular products. In some cases, because of the close researcher and user interaction, the output of interim or prototype products have been put into use before the final product has been completed. Examples of NPRDC's on-site research applications are shown in Appendix A.

Further interaction with operational commands involves a variety of valuable MPT data bases that NPRDC has developed and maintained. Because NPRDC is an

in-house, corporate laboratory, these data bases are readily available to support many different operational users and requirements. The data bases, descriptions, and principal users are shown in Appendix B.

Funding

NPRDC operates under the research, development, testing, and evaluation (RDT&E) Resources Management System. Under this system, the final fiscal responsibility resides with the Commanding Officer and certain financial responsibilities are delegated to cost center managers. The reporting procedures associated with the Resources Management System provide financial information for both internal management and higher authority.

The principal mission sponsor--and prime "customer" for Center RDT&E products--is the Deputy Chief of Naval Operations for Manpower, Personnel and Training (OP-01)/Naval Military Personnel Command. Significant sponsorship also comes from the Chief of Naval Research, the Marine Corps, and other Navy and DoD organizations, including the Systems Commands. The majority of RDT&E that the Center conducts is supported by direct Program 6 R&D funds, with 6.2, 6.3, and 6.4 efforts accounting for nearly all directly funded projects. A small portion of the funds are independent research (IR) and independent exploratory development (IED). In addition, a substantial portion of research, development, and analysis consists of "reimbursables"--specific problem-solving efforts requested by, and supported with funding from other organizations.

Personnel Staff Composition

Because R&D programs at NRPDC are mission-oriented, it is essential that the research force be multidisciplinary so that early consideration may be given to alternative approaches in research endeavors. The Center's staff is creatively diverse and equipped to meet this prerequisite.

The staff numbers approximately 23 military and 300 civilian personnel. Of the civilians, a little over 200 are professional and technical personnel representing a variety of disciplines. Of the professional and technical staff, 70 percent hold advanced degrees. The military staff consists of line officers and senior enlisted personnel. The military personnel offer extensive fleet and subject-matter expertise that helps ensure the operational relevance of NRPDC's R&D endeavors. This broad personnel base allows NRPDC to maintain a highly effective, multidisciplinary team approach to its R&D.

computational and electronic mail support for research in areas of artificial intelligence, computer-assisted instruction, cognitive science, testing, and training. The TRCF equipment suite includes two Digital Equipment Corporation (DEC) VAX-11/780 computers and numerous peripherals.

- Manpower and Personnel Computing Facility (MAPCOM)--Provides general purpose IBM-based computing services for Center researchers and administrative operations. The facility is specially equipped to serve psychologists, economists, mathematicians, and computer scientists whose research requires the organization and analysis of large data files, the development of large-scale mathematical models, the design of information delivery systems, and general-purpose scientific computing. The MAPCOM features an IBM 4381/23, multiple tape drives, and over 25GB in disk storage.
- System Simulation Facility--Serves cognitive and organizational psychologists who are concerned with the measurement of human performance, neuroscience applications in personnel readiness assessment, and motivation of people in organizations. It includes equipment for biopsychological and psychophysiological measurement.
- Training Research Computing Facility (TRCF)-- Provides general Unix-based computing services and access to the Defense Data Network (DDN) for Center research and support staff. The facility is supported by the Training Technology Department and provides

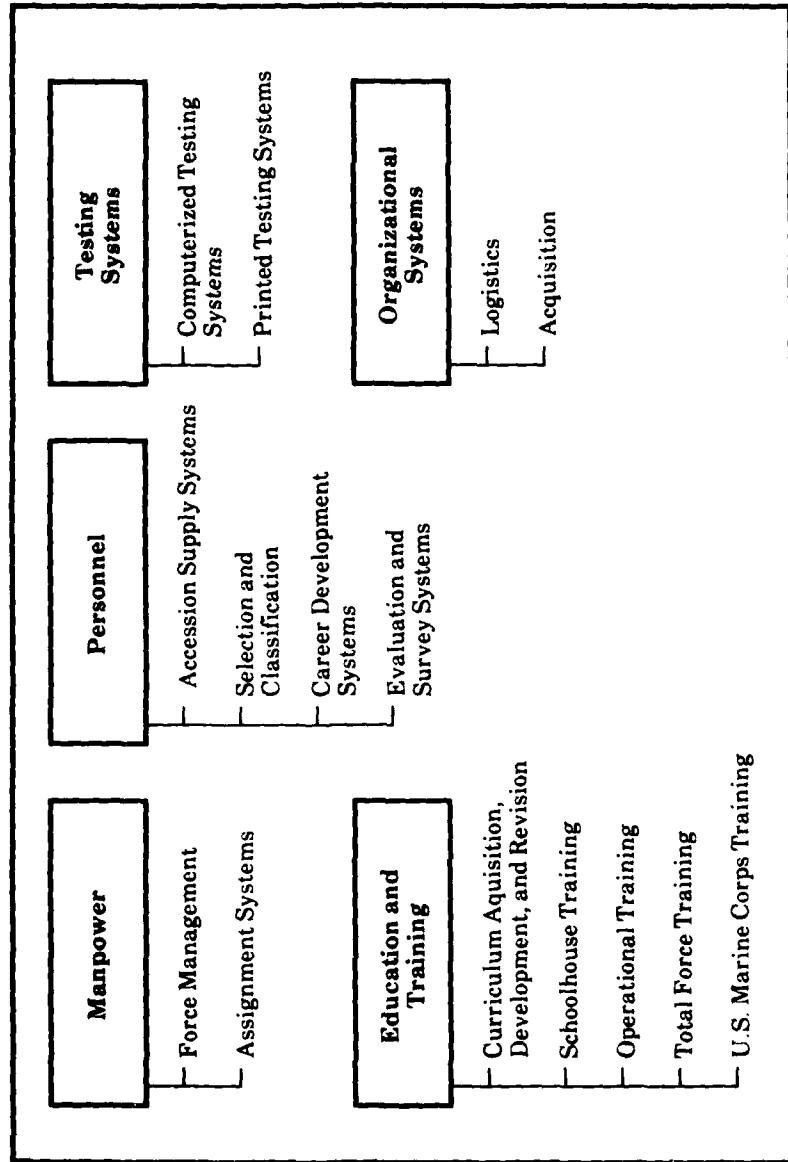
Facilities

NRPDC is located on Point Loma in San Diego, California, with support offices in Washington, DC. The Center occupies 17 buildings under a host-tenant arrangement with the Naval Ocean Systems Center. In addition to office space for research and support personnel, the following research facilities are housed at the Center:

- The above facilities are supplemented by two mobile laboratories that provide R&D support at sites away from the Center, and by a large inventory of computer equipment ranging from microcomputers supporting specific projects to the Center's IBM 4341, which is used both as a stand-alone processor and as a remote job entry station.

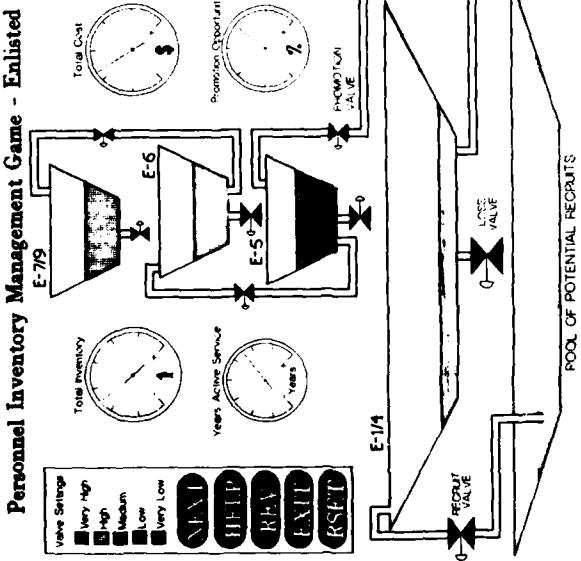
NPRDC Functions and Product Lines

The research and development program at NPRDC addresses five functional areas: **Manpower, Personnel, and Testing Systems, Education and Training, and Organizational Systems**. Within these five functional areas we have 15 product lines, each of which has one or more projects. The remainder of this publication describes these functional areas, product lines, and selected projects.



Applications of Manpower Systems

Force Management



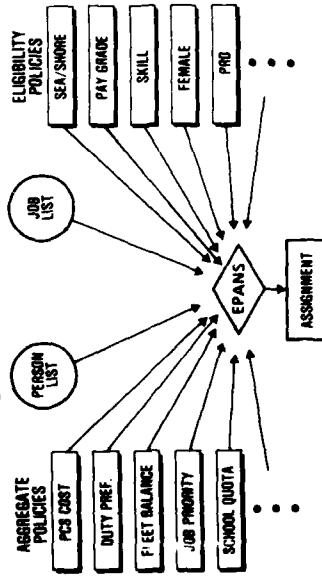
Manpower Function and Product Line Descriptions

Force Management - Develops new systems and methods for determining manpower requirements, allocating manpower resources, developing personnel inventories, and distributing/assigning those inventories to improve military readiness and control costs.

Force Management - Develops large-scale systems for managing the flow of personnel (accessions, retention, promotion) to attain desired skill inventories within constraints of cost and feasibility.

Assignment Systems - Designs systems for optimal job-person matches based on cost, fleet requirements, individual preferences, and a wide variety of assignment policies.

Assignment Systems



Total Force Manpower Tradeoffs

Principal Investigator:

Michael Shoecraft
(619) 553-8038



manpower requirements and billets authorized for Navy enlisted ratings and officer designators by pay grade, Defense Planning and Programming Category (DPPC), and resource sponsor (e.g., air warfare, surface warfare).

manpower requirements and billets authorized for Navy enlisted ratings and officer designators by pay grade, Defense Planning and Programming Category (DPPC), and resource sponsor (e.g., air warfare, surface warfare).

In FY87, the Manpower Personnel Training (MPT) Assessment Subsystem and the Manpower Requirements Allocation Data Display (MRADD) were installed in the Office of the Chief of Naval Operations (OP-12G). The MPT assessment subsystem will enable manpower planners to investigate the balance between requirements and authorizations.

Planning for the Navy of the future requires a knowledge of the manpower consequences of future force levels. At present, the Navy lacks quick and relatively accurate methods of assessing the impact of alternative fleet sizes and configurations on the requirement for support manpower. This deficiency is highlighted as the Navy seeks to achieve a force strength of 15 battle groups and 600 ships.

Improved methods are needed to project support manpower requirements through the Extended Planning Annex (EPA), 17 years out, and to verify manpower authorizations projected 2-7 years in the future in the Department of the Navy Five-Year Defense Plan and during the Program Objectives Memorandum (POM) process. Total force manpower (active military, reserve military, civilian, contractor) must be evaluated to achieve a cost-effective support force. The objective is to develop systems to support these manpower planning and allocation functions.

A system was developed to support the manpower, personnel, and training baseline assessment. This system allows comparisons of

authorizations and avoid critical manpower shortages in important warfare and support programs.

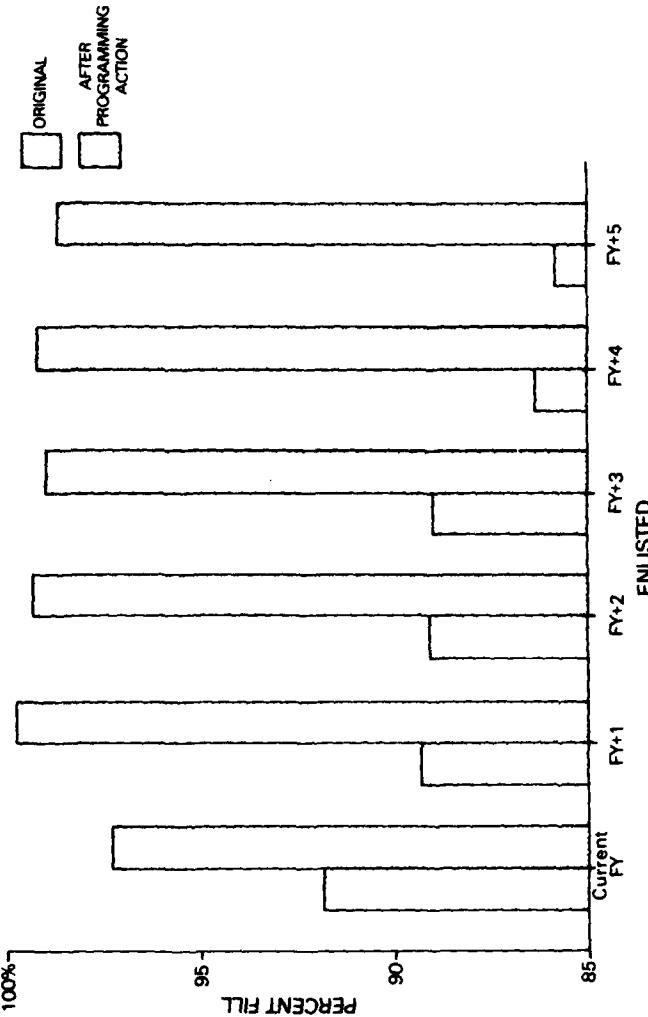
In FY88, an aggregate projection of officer manpower requirements was determined by community and pay grade for the shore establishment.

In FY89, it will be expanded to include an evaluation of the officer/civilian cost tradeoffs.

P.E. 0603707N

Report: *Shoecraft, M. R. (1985). An aggregate manpower projection model for long-range planning (NPRDC TR 85-25). San Diego: Navy Personnel Research and Development Center.*

ASW & FLEET AIR DEFENSE FORCES



Decision Simulators for Manpower Management (IMAGE)

Principal Investigators:

Carolyn Macky
(619) 553-8033/8018



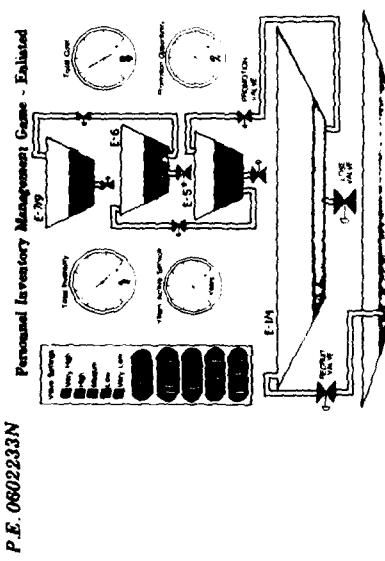
A prototype of a computerized training simulator for manpower management has been developed. The simulator, known as IMAGE, will enable manpower managers to acquire an understanding of how military personnel systems behave, to grasp the essential techniques for managing these systems, and to see how these systems respond to changes in policy. Simulations take the form of "management games," which are represented by a series of decision scenarios simulating the management environment of manpower planners. Knowledge acquired in "playing" these games facilitates the operational use of a variety of personnel flow models used in managing the military personnel force. Managers will gain experience by using IMAGE to test the effects of their hypothetical decisions on the size, shape, and cost of the personnel inventory.

The success of military manpower managers is due more to their individual intelligence and energy than the procedures used to prepare them for their jobs. Because of insufficient overlap between succeeding incumbents, many officers arrive at a manpower management position with little or no orientation from his or her predecessor. Lacking specific manpower management experience, many officers require a significant amount of time on the job before they become effective. Consequently, most officers learn personnel force management on the job. Force management decisions have far-reaching readiness and financial impacts. The opportunity for managers to sharpen their decision-making skills is desirable, but practicing on the personnel system itself is unacceptable. Like a pilot using a flight simulator, manpower managers need the capability to develop, freshen, and refine their skills without fear of harming the personnel system (or their careers).

bucket sets the desired level of personnel strength for that grade. Adjacent buckets are linked by pipes, each with a valve regulating promotion flow from grade-to-grade. The bottom of each bucket has a valve regulating losses (or its complement, retention) from that grade. By manipulating the valves, the manager exercises a measure of control over the level of personnel in each grade relative to requirements.

A prototype of IMAGE has been installed in the Pentagon under the aegis of the Deputy Assistant Secretary of Defense (Manpower). This prototype will be used by Army, Air Force, and Coast Guard personnel, as well as GAO staff. Two other prototypes were installed in the Headquarters, USMC and in the offices of the DCNO(MPFI) for use by Marine Corps and Navy personnel, respectively.

This project will investigate the effectiveness of interactive training procedures in the field of personnel force management using experimental data on actual decision-makers. Alternative approaches in intelligent tutoring, media presentation, and human/computer interaction will be tested for their effectiveness in improving the decision-making skills of manpower managers.



Force Management

Marine Corps Qualified Military Available (QMA)

Principal Investigators:

Murray Rowe

Mark Chipman
(619) 553-8027/8030



To refine the market potential of the military at the county level, the development of indicators that measure the QMA's propensity to enlist was initiated. Finally, a prototype interactive QMA data delivery system was constructed.

In FY86, work was started to incorporate economic, demographic, and prior recruiting history data into a Qualified Military Interested index—an estimate of the "propensity to enlist." Also, the QMA data processing procedures were streamlined, resulting in decreased processing time, as well as improved error checking. In FY87, work on development of a model designed to project potential recruiting shortfalls within Marine Corps recruiting districts was begun.

The interactive micro-computer version of the QMA data base has been installed at Headquarters U.S. Marine Corps and has been updated through 1991. An index to gauge interest in joining the Marine Corps by geographic area was also developed.

In FY88, the QMA data base was maintained and updated as required.

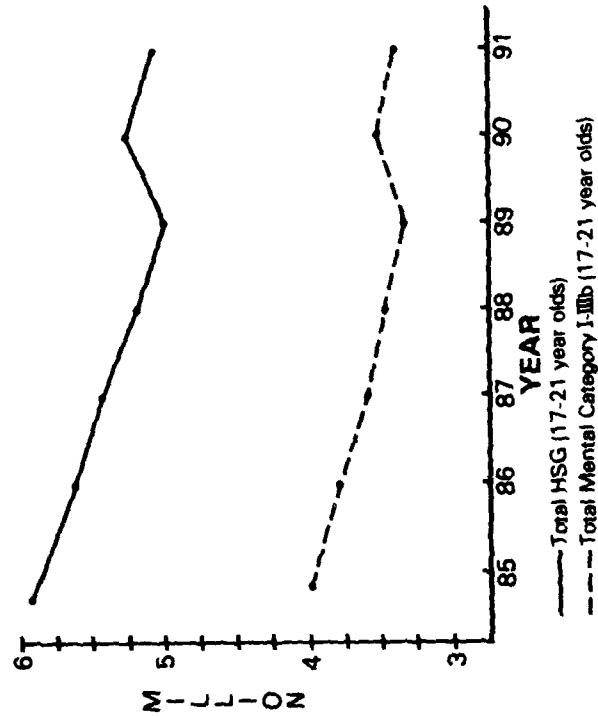
Reimbursable (O&M, MC) Reports:
Curtis, E. W., Borack, J. I., & Wax, S. R. (1987). *Estimating the youth population qualified for military service (NPRDC TR 87-32)*. San Diego: Navy Personnel Research and Development Center.

Projected High School Graduates and Mental Category I-IIIb's Among 17-21 Year Olds

The supply of young men available for potential recruitment into military service varies greatly in both quality and quantity across the United States. Consequently, the allocation of recruiting and selection resources to individual states and counties has been a difficult process. This difficulty has included the establishment of recruiting quotas and the allocation of recruiting funds. To effectively address these issues, an accurate estimation of the number of young men available for recruitment in each county is needed. The objective of this effort is to provide the Marine Corps with county-level estimates of the number of male high-school graduates, 17-21 years old, who are physically and mentally qualified for Marine Corps service.

Forecasts of the number of mentally and physically qualified male high-school graduates, aged 17-21, for the period 1984-1991, have been developed at both the national and local levels using updated and improved population estimates.

Manpower



Officer Personnel Management Models

Principal Investigator:

Mark Chipman
(619) 553-8030



A prototype of the STRAP-O system has been operational in OP-13 since 1981. Initial versions were limited to modeling the unrestricted line communities. STRAP-O now has the capability to project personnel structures for the unrestricted line, restricted line, and staff corps communities, as well as for the total officer force.

STRAP-O can also model separately the jet, propeller, and helicopter portions of the aviation community, and the nuclear and non-nuclear portions of both the surface and submarine communities. An end-of-obligation date (EOD) for all officers was also developed and validated. This date is particularly useful in making retention/bonus decisions and accession policies.

An Officer Personnel Information System (OPIS) was completed. The system is composed of modules that enable managers to display a variety of inventory, personnel flow, and retention statistics in both graphical and array formats.

To meet current and future needs for officers, the Navy must forecast losses and devise plans for accession, promotion, and training that will produce the desired personnel structure. To do so requires the development of techniques to improve the accuracy with which force planners predict personnel flows, develop personnel policies designed to meet officer manpower requirements, and track the effects of those decisions on the structure of the force. Without these techniques to guide policy decisions, inventory excesses or shortages may occur or persist.

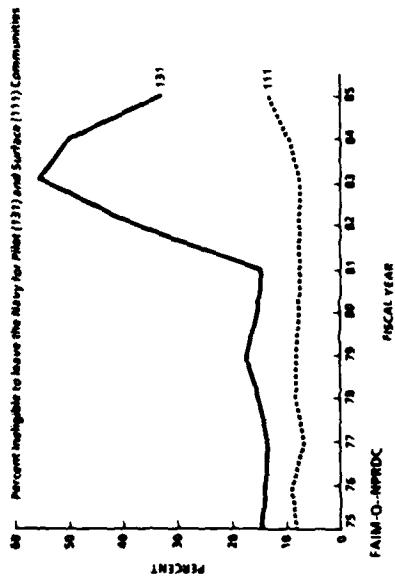
The objective of this project is to support a set of computer-based models and data bases to assist in the development of a Navy officer force that meets its manpower requirements. Work has focused on the structured accession planning system for officers (STRAP-O). Operationally, STRAP-O has provided a common "playing field" for promotion and accession planners, retention and compensation managers, strength planners, and community managers concerned with the feasibility of future manpower plans.

Reports:

Chipman, M. (in press). Using STRAP-O: Some applications. San Diego: Navy Personnel Research and Development Center.

Mullins, C. (1986). Development of a Navy officer end-of-active-obligated-service (EOAS) date (NPRDC TR 86-11). San Diego: Navy Personnel Research and Development Center.

Mullins, C. (1984). Navy medical officer retention behavior (NPRDC TR 85-12). San Diego: Navy Personnel Research and Development Center. (AD-A157 807)



In FY87, the STRAP-O model was updated and a new Conversational Control Monitor was implemented, which simplified the use of STRAP-O. The officer historical data base (FAIM-O) was updated with FY86 data and a medical community data base was updated with FY87 data. OPIS was updated and expanded to display aviation officer data by squadron type.

In FY88, three new Navy-sponsored education programs which incur obligation were added into the FOD estimation process. FAIM-O will be updated with FY87/88 data. OPIS will be expanded to incorporate FY88/89 begin year inventory and FY87/89 flow data. This version will include two new designators, Health Care Professionals and Aviation Duty Officers.

Reimbursable

Permanent Change of Station (PCS) Moves

Principal Investigator:
Robert Holmes
(619) 553-8037



The objective of this project is to develop statistical techniques that can produce accurate and defensible move forecasts for officer and enlisted operational, rotational, and training (ORT) moves. ORT moves represent about 40 percent of all PCS moves as opposed to non-discretionary moves, such as accession,

separation, and organized unit moves. ORT moves are considered discretionary moves. A review of existing methods used by the Naval Military Personnel Command (NMPC) to forecast moves will be undertaken, and machine-readable historical PCS moves data will be collected, organized, and analyzed. With a move data base established, the forecasting problem will be approached from both an aggregate and a disaggregate perspective. An exploratory, bottom-up modeling approach to developing the budget estimate will be investigated, as well as an aggregate level, time series approach for sizing the problem and verifying the forecast of the detailed model.

Annually, the Navy moves roughly 300,000 of its officers and enlisted personnel. These moves are made to: (1) bring new accessions to recruit training and later to their first duty stations, (2) send personnel to required training courses, (3) rotate personnel to new assignments, and (4) relocate crew members when a ship changes home-port. The moves are collectively known as permanent change of station, or PCS, moves.

The Navy spends over \$500 million on PCS moves each year. These costs are part of the Navy's \$17 billion Military Personnel Navy (MPN) budget. In the formulation of the MPN budget for future years, the number of required PCS moves must be accurately estimated to ensure that adequate funds are available during budget execution to accommodate moves needed to operate and maintain the fleet. The estimated requirements for PCS moves must be defended within the Navy and, ultimately, before Congress, as part of the MPN budget justification process. The manual methods currently used to estimate move requirements are sometimes inaccurate and difficult to defend.

In FY87, this method was validated, and both aggregate and disaggregate models to forecast enlisted ORT moves were developed. An interactive system to access and run the models was designed, and development of the system was begun.

In FY88, the enlisted ORT Move Requirements system was completed and an investigation into methods for forecasting officer ORT moves was begun.

In addition, an evaluation of the method currently used by the Navy to project PCS expenditure rates was conducted and recommendations to improve the projection method were proposed.

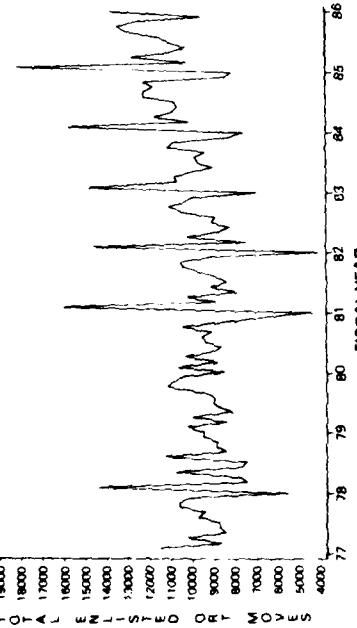
In FY89, the officer ORT Move Requirements system will be completed.

Reimbursable

Reports:

In Holmes, R. M., Jr., & Pinciaro, S. J. (1986). *Problems in estimating the permanent change of station (PCS) move requirements*. *American Statistical Association Proceedings of Business and Economic Statistics Section*, 637-641.

ENLISTED PCS ORT MOVES



Budget Obligation Analysis and Tracking System (BOATS)

Principal Investigator:

Dennis Schurmeier
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Last year, the Navy spent approximately \$17 billion to pay its military personnel. These payments are made from the Military Personnel, Navy (MPN) budget, which is managed by the Naval Military Personnel Command (NMPC-7). Responsibility for managing the MPN budget requires a continuing assessment of how much money the Navy owes its members, and the monitoring of these financial obligations with respect to planned monthly spending levels. These management functions are performed separately for over 100 pay and allowance categories (called entitlements), including basic pay and basic allowance for quarters. Most of these pay and allowance categories are composed of numerous subcategories, resulting in hundreds of entitlements for which obligations must be calculated and tracked during the year.

To determine obligations each month, the Navy's budget analysts rely on entitlement data from the Joint Uniform Military Pay System (JUMPS). The necessary data are extracted from a voluminous report called the Accrued Entitlement Detailed Classification Code Report. This report is also called the 1M Report. Data transcribed from the 1M are compiled and used to estimate year-to-

date obligations. Due to lags in the reporting system, obligations must be estimated each month because the current month's entitlement amounts reported by JUMPS are incomplete. Obligations are estimated based on observed patterns of retroactive entitlements, which are also reported in the 1M. Obligation estimates are compared to planned year-to-date expenditures. This comparison reveals whether the budget is being executed according to plan, or if corrective actions are needed.

The manual extraction, transcription, and manipulation of the data needed to estimate and monitor obligations is very time consuming. The objective of this effort is to develop a computerized system, called the Budget Obligation Analysis and Tracking System (BOATS), for retrieving past and current JUMPS data, for computing current obligation estimates, and for tracking estimated year-to-date obligations via planned expenditures.

Efforts to date have produced a data base of JUMPS data from July 1981 to the present for over 400 entitlements, by pay grade and length of service where appropriate. Interactive software for retrieving these data in graphic and array formats has been developed. In addition, software to derive monthly obligation estimates for all 400 entitlements and to interactively retrieve and/or override these estimates have been developed. BOATS has simultaneous multi-user capability. It is used interactively by NMPC-7 budget analysts to retrieve system-generated obligation estimates each month, to evaluate these estimates with respect to current and historical JUMPS data, and to enter their overrides to the system's estimates of obligations.

In FY86, the JUMPS data base and data base updating system were expanded to capture retroactive entitlement for a longer time frame

than was previously reported by JUMPS. Modifications to the retrieval software were made to enable user access to the expanded data base. In FY87, a budget monitoring module of BOATS was developed. The module enables the comparison of year-to-date obligations to year-to-date planned expenditures to determine if the budget is being executed according to plan. If not, the monitoring system assists in targeting corrective policies by enabling the tracking obligations for over 400 pay and allowance budget categories.

In FY88, the feasibility of incorporating MPN expenditure data into BOATS was investigated, as well as the feasibility of developing a BOATS-like system for managing/monitoring the Reserve Personnel, Navy (RPN) budget. Linkages from BOATS to the NMPC-7 in-house MPN budget development system will be developed in FY89.

Reimbursable

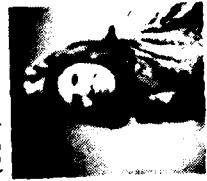
Reports:

Pinciaro, S. (in press). *The Budget Obligation Analysis and Tracking System (BOATS) and its role in Military Personnel, Navy (MPN) budget management. In Sheldon (Ed.), Governmental Financial Management Research Issues, Proceedings of the Twentieth Annual Hawaii International Conference on System Sciences I, 715-724.*

Marine Corps Enlisted Planning System

Principal Investigator:

Carol Mullins
(619) 553-8026



During FY86, a final report describing the current Marine Corps enlisted planning system was produced. The report documented system deficiencies and offered a set of recommendations for improving the current enlisted planning system. A "blueprint" was subsequently developed that outlines the structure of a new enlisted planning system—the models, the data and data bases, and linkages among models. The blueprint was used to prepare an agenda for the development of new planning models, and the revision of currently existing models in support of the new enlisted planning system.

The objective of this project is to determine the constituent parts, relationships, and operational behavior of the Marine Corps enlisted force management system. This effort also addresses the extent to which the current system satisfies the needs of Marine Corps managers. A baseline description of the current system and recommendations for improvement will be prepared. Taken together, both will support a "blueprint" for a new or modified system.

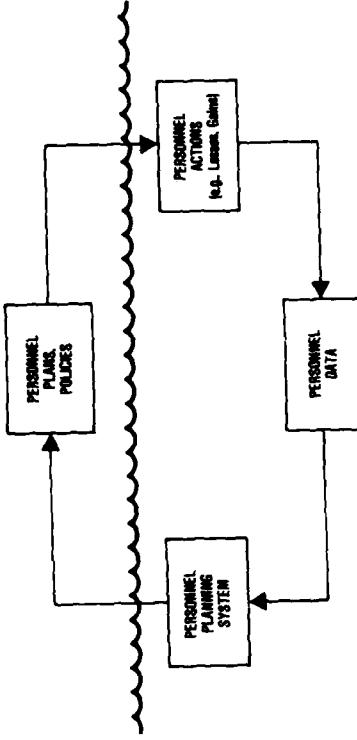
During FY88, the prototype enlisted rate generator was designed and built. The rate generator provided the IPM with forecasted end-of-active service (EAS) and non-EAS loss rates. The design of the prototype IPM has been completed. The IPM will produce forecasts of Marine Corps enlisted inventories and flows by pay grade and year of service for up to 7 years. The prototype IPM was delivered to Marine Corps users during the fourth quarter of FY88. During FY89, the prototype IPM will be enhanced. Specifically, skills will be added as well as additional personnel flows including lateral transfer and reenlistments. Also during FY89, a prototype manpower planning model (MPM) will be designed and built. The MPM is a monthly phasing model which distributes the forecasted flows from the IPM across the 12 months of each fiscal year.

In FY87, a historical enlisted force data base was completed. The data base will supply existing and anticipated force management models with inventories and flow rates (e.g., loss rates).

Historical force behavior (e.g., losses, gains) was analyzed using the data base. Preliminary work was begun on the design of a new Inventory Projection Model (IPM), the central piece of the new Enlisted Planning System. Finally, required Marine Corps Life Cycle Management documentation, including an Economic Analysis and a Requirements Statement were completed.

To determine what comprises the current system and to describe how it works, a "structured analysis" of the system was conducted. The system was viewed from a number of different, but interrelated, perspectives. The scope of the enlisted personnel planning system was described and the organizational relationships involved in the planning process were determined. Models and other automated planning tools, as well as the data used in the system, were explored. The analysis was conducted primarily through planner/manager interviews.

ENLISTED PLANNING SYSTEM IN CONTEXT OF ENLISTED PERSONNEL SYSTEM



Mullins, C. (1987). An assessment of Marine Corps enlisted personnel data (NPRDC TR 87-26). San Diego: Navy Personnel Research and Development Center.

Reports:

P.E. 0603732M

Marine Corps Officer Loss Forecasting

Principal Investigator:

Barry Siegel

(619) 553-8022



Marine Corps manpower managers adjust the size and shape (grade and experience mix) of the officer corps by exercising control over promotions and accessions. Since they have less control over losses, they try to forecast losses accurately. Losses play a central role in the operation of military personnel systems. Critical personnel actions, such as promotions and accessions, are initiated by the creation of vacancies. Vacancies are largely the result of losses. Losses in the pay grade hierarchy trigger promotions from lower grades. Vacancies also generate the need for new accessions to replenish or expand the force.

The objectives of this effort are to (1) develop a data base system to permit easy retrieval of historical Marine Corps officer personnel data and (2) devise interactive techniques to forecast loss behavior over a 7-year planning horizon. These techniques must be able to capture the effect that external factors, such as employment conditions and personnel policies, have on retention decisions. These forecasts provide the retention rates for officer manpower planning models currently under development at Headquarters, U.S. Marine Corps.

A production version of the Marine Corps Officer Rate Projection (MCORP) has been designed and installed at Marine Corps Headquarters to provide forecasted loss rates for existing officer manpower planning models, or permit "what if" exercises under a variety of policy alternatives (e.g., changes in military pay, changes in civilian employment conditions). MCORP has the capability of displaying historical and/or projected loss and continuation rates.

A longitudinal personnel data base has been developed. It provides personnel inventories and loss rates by grade and promotion status, year-of-service, military occupation specialty (MOS), sex, source of commissioning, and other variables. Using data base access techniques, the software retrieves historical and/or projected inventories and rates by all possible combinations of variables.

Both time-series and econometric loss forecasting methodologies have been implemented in MCORP. The time-series technique is based on historical exponential weighting or Minimum Absolute Deviation (MAD) regression. The econometric approach is based on the "annualized cost-of-living" model, commonly called ACOL, which estimates the changes in loss behavior that are expected to occur in specific skills as a result of changes in compensation policies, including basic pay, retention bonuses, and retirement benefits. Other variables that impact loss behavior, such as civilian employment conditions and the socioeconomic characteristics of the force (e.g., race, education), are also analyzed. Uncertainty in multiple year forecasts is accounted for by a "wear off" function, which provides for the migration over time of the loss rate forecasts to a historical average. The purpose of the wear off function is to avoid the potential for large forecast errors that may result from projections that are based on recent values that represent historical extremes.

In FY89, MCORP will be updated with FY88 data.

MCORP has been modified to provide retention rates for the Marine Corps' inventory projection and promotion planning models.

P.E. 0603732M



Military Personnel Cost Projection

Principal Investigator:
Susan Pinciaro
(619) 553-8024



The financial obligations for military pay and allowances are incurred by the Navy throughout the fiscal year, but not all obligations are reported in the month they occur. Part of the total obligation attributable to a specific month is reported, or observed, in up to 35 subsequent months. This phenomenon is called "rollback."

Rollback occurs due to delays in transmitting members' entitlement information from field activities to the Navy Finance Center (NFC) in Cleveland, Ohio, where the Military Master Pay Account records are centrally maintained. In addition, the time needed to process and edit this data after receipt by NFC further contributes to rollback. The magnitude of rollback varies from month-to-month, year-to-year, and from one budget category to another. The Naval Military Personnel Command (NMPC-7) has a two-fold need to forecast rollback accurately. First, rollback must be estimated in order to determine how much money to obligate to fund the Navy's year-to-date financial commitments for military pay and allowances. Second, accurate estimates of rollback must be made to determine whether the budget is being executed according to plan or whether appropriate corrective actions are required.

The functions of obligation determination and budget execution monitoring are currently performed manually by NMPC-7 budget analysts, including the task of forecasting monthly rollback for each of approximately 120 budget categories. The objective of this effort is to develop statistical models for forecasting rollback at any desired level of budget category detail, including pay grade and length of service (LOS), where appropriate. Model development is difficult due to limited historical data and the need to reserve 36 months of data for validation.

Efforts to date have yielded rollback forecasting models for 120 budget categories, their component categories, and their pay grade/LOS dimensions. These models are based on rollback patterns observed since FY81. The model's FY84 estimates have been validated against actual rollback totals, as of December 1985. Accuracy to within 15 percent of actual totals has been observed. As a result, the model's have been incorporated into the Navy's Budget Obligation Analysis and Tracking System (BOATS) as an automated means of estimating year-to-date financial commitments.

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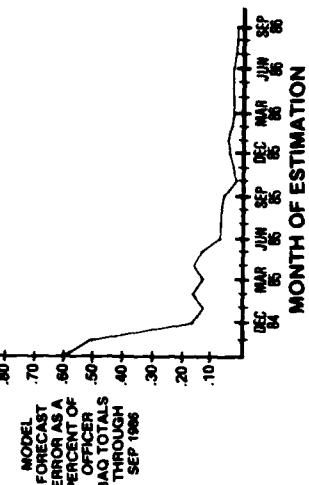
Reports:

Pinciaro, S. (in press). *The Budget Obligation Analysis and Tracing System (BOATS), and its role in Military Personnel, Navy (MPPN) budget management. In Sheldon (Ed.), Governmental Financial Management Research Issues.*

Pinciaro, S. (1987). *Lessons learned in developing a decision support system for managing the Navy's military personnel budget. In Stohr, Hauel, Chu, Hayes, and Specht (Eds.), Proceedings of the Twentieth Annual Hawaii International Conference on System Science, 1, 715-724.*

Pinciaro, S. J. (1985). *Estimating the Navy's year-to-date obligation for military pay and allowances. In the 1985 Proceedings of the Business and Economic Section of the American Statistical Association, 565-569.*

PERCENTAGE ERROR IN MODEL FORECAST
FOR OCTOBER FY 85
FOR QUARTERS (BAQ)
OFFICER BASIC ALLOWANCE



In FY86, alternative forecasting models were investigated to incorporate structural changes in rollback patterns due to improvements in the JUMPS reporting system. In FY87, an automated validation system was developed for assessing the performance of different forecasting models. New arrays and models for budget monitoring were added and the package delivered to NMPC. Also, in FY87 capabilities were added to BOATS to enable the use of rollback forecasts in monitoring budget execution. In FY88, the validation system was completed. In FY89, forecasting methods will be developed for Navy expenditures associated with permanent change of station (PCS) moves.

Defense Personnel Analysis Systems (DPAS)

Principal Investigator:

Murray Rowe
(619) 553-8027



services. Functions within each subsystem permit the user to display data (e.g., inventories by service, skill, grade, and time in service) or to transform the data (e.g., create a loss rate) and then display it. In FY87, these subsystems were expanded to include gender and ethnic group dimensions. The Objective Force subsystem accommodates desired or projected forces. In FY86, an Officer Personnel Subsystem was developed.

A prototype version of an officer inventory projection model was installed for use by OASD (manpower) during officer strength reduction

Major policy and programming decisions in the area of manpower and personnel management are made under severe time constraints and with very limited amounts and kinds of information. This deficiency in decision-making information persists in spite of accelerating advancements in computer technology.

The objective of this project has been to develop an information delivery system (IDS) for the Office of the Assistant Secretary of Defense (OASD)-Force Management and Personnel (FM&P) that focuses on management decisions with the appropriate volume, form, and frequency of data.

The approach capitalizes on advances in information technology (e.g., computer generated graphics displays) and interactive software design. A demonstration version of the DPAS was completed at the end of FY84 and subsequently installed at OASD.

Since that time, several subsystems have been added. The Enlisted Personnel (Graphics) and the Enlisted Personnel (Array) subsystems allow the user to retrieve inventory, promotion, loss, and gain data for each of the four military

exercises. The DPAS system was made available to the individual service's personnel planning organizations for test and evaluation.

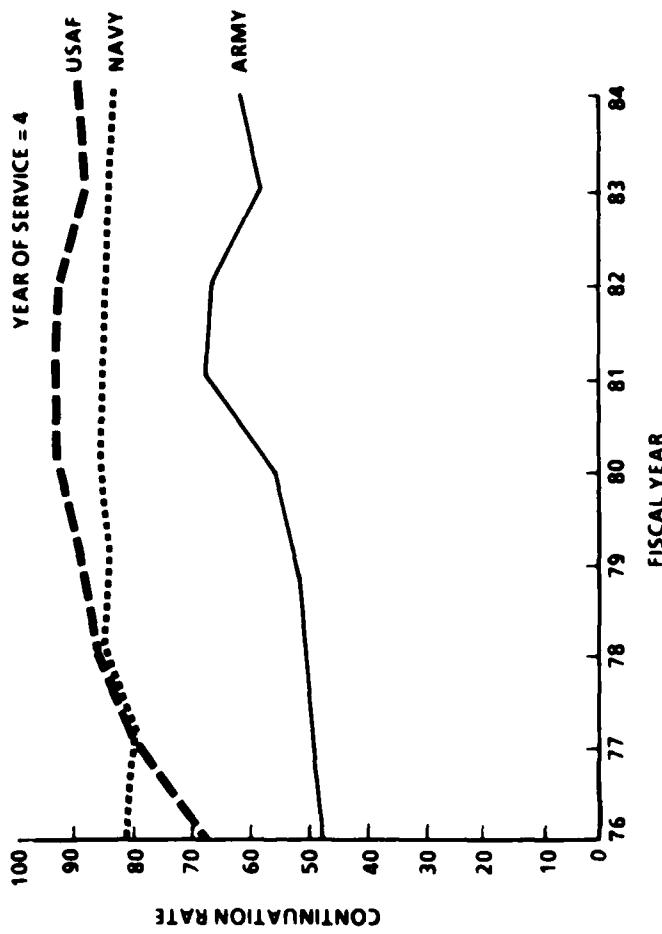
Future efforts will focus on development of an enlisted bonus management subsystem.

Reimbursable

Reports:

Dickesson, J., & Rowe, M. W. (1986). *The evolution of an information delivery system: Descendants of DELIS*. In Chu, Haynes, Hoewel, Speckard, Stohr, & Sprague (Eds.), *Proceedings of the Nineteenth Annual Hawaii International Conference on System Sciences*, 426-433.

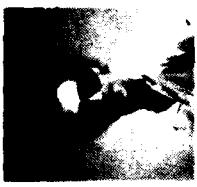
CONTINUATION RATE BY SERVICE



Personnel Planning Data Development

Principal Investigator:

Roy Jordan
(619) 553-8031



developed and tested. A production version of the integrated model was made available for user evaluation.

The ADIN system, used by the enlisted advancement planner to distribute advancements by rating by month, was made easier to use by adding features to its interactive "front-end." In addition, the FAST Manager's Report, which uses the ADIN data base to assist the FAST manager in evaluating FAST output, was completed and made available for production use.

The accuracy and reliability of enlisted personnel planning models depend on the quality of their underlying data bases. Each model requires data in certain formats and employs parameters that must be periodically reestimated. Without effective systems of data support, the models soon lose their designed capabilities.

The objectives of this project are to provide data support for the Navy's enlisted personnel planning system and to provide technical support and development for several of the Navy's enlisted personnel forecasting and planning models, including Force Analysis Simulation Technique (FAST), and Advancement Interface System (ADIN).

To accomplish these objectives, data must be collected from a variety of sources, then organized and processed, and data inputs generated to fit the operational models. The organization responsible for enlisted personnel planning is the Deputy Chief of Naval Operations (OP-135).

A version of the FAST model integrating two additional models (which project automatic advancements and allocate recruits) was

structures agree with the current rating structure. Both models and their data bases were expanded to allow for up to 120 ratings.

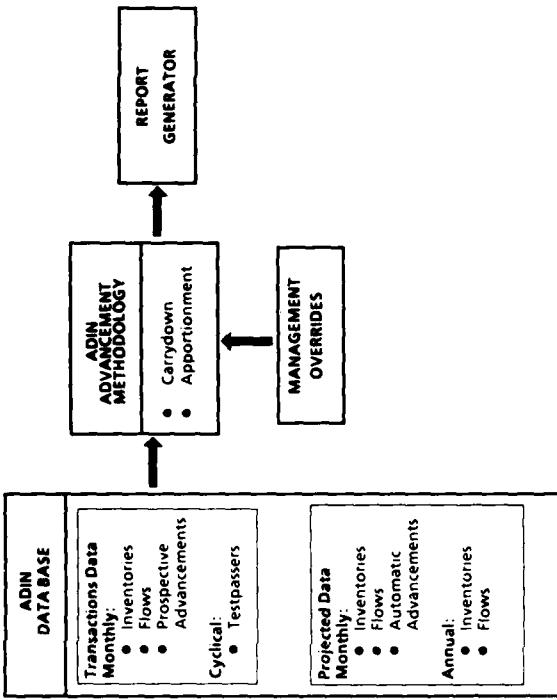
In FY89, FAST and ADIN will be maintained and updated as needed.

Reimbursable

Reports:

In FY87, the data bases for FAST and ADIN were updated. The models and their data bases underwent a major revision to have their rating

Jordan, R. (1987). *Navy enlisted advancement planning and the advancement interface system (ADIN)* (NFRDC TR 87-17). San Diego: Navy Personnel Research and Development Center.



The Advancement Interface System (ADIN)

Distributable Inventory Management Information System (DIMIS)

Principal Investigator:
Susan Pinciaro
(619) 553-8024



personnel inventories and flows. An extensive data dictionary was built to define personnel flows based on the data elements. Computer programs were developed that use the data dictionary and individual-level data to produce historical inventory and personnel flow counts at the required levels of detail. Finally, programs were developed to convert the historical data into rates for use by projection models.

The second thrust involves evaluating the feasibility and accuracy of alternative techniques for forecasting personnel inventories. The high incidence of "small cells" in DIMIS will require the development of specialized forecasting techniques. "Small cells" are personnel flow or inventory categories containing insufficient numbers of personnel to estimate stable rates.

The third thrust is the development of an information delivery system (IDS) for retrieval of historical and projected personnel inventory and flow data. Alternative data base structures, storage techniques, access methods, and graphics packages will be considered in designing the IDS. A small-scale prototype will be developed and modified, as required, based on user feedback. In this way, the system will be tailored to the needs of the user.

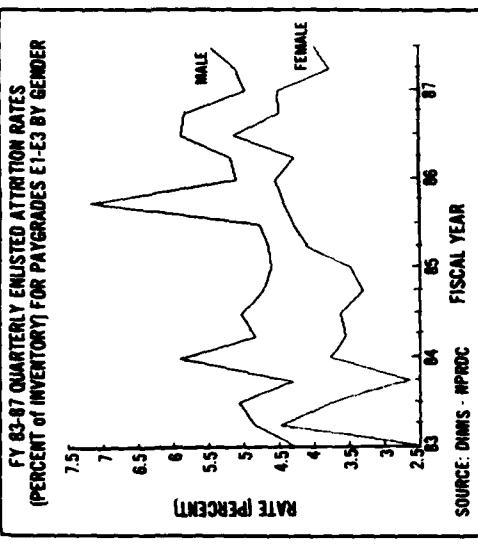
Several times each year, as part of the Navy's military personnel budget cycle, the Deputy Chief of Naval Operations (OP-135) must develop accession, promotion, training, and strength plans. The planning tools available to OP-135 do not forecast personnel inventories at the levels of detail needed for the effective management of the Navy's enlisted personnel. Specifically, no tools are available to forecast inventories and personnel flows (e.g., attrition, reenlistment) for the sea/shore, male/female, and operational/overhead components of enlisted ratings. The objective of this project is to develop an integrated system of projection models, data bases, and information delivery software to produce these forecasts and provide interactive access to them and to the historical data upon which they are based. The system, called the Distributable Inventory Management Information System (DIMIS), will support OP 135 in enlisted skill community management and personnel policy analysis and development.

The DIMIS effort will be characterized by several thrusts. The first thrust, data base development, was begun in FY87. This effort identifies the relevant data sources and data elements necessary to derive the required

In FY87, algorithms were developed to derive inventories of the sea/shore, male/female and operational/overhead components of the enlisted force from the enlisted master records and individual-level transaction records. Algorithms were also developed to track personnel flows into and out of these components. A prototype data base of historical inventory and flow counts was developed for a subset of ratings. Interactive data retrieval capability was developed to permit easy access to this data.

In FY88, user feedback from the prototype data base/IDS was used to refine the data base and retrieval software to best meet OP 135's needs. Alternative forecasting techniques will be evaluated by applying them to data from the prototype data base. In addition, attention will be focused on developing inventory projection capability for all relevant enlisted force components. A prototype inventory projection model will be developed in FY89.

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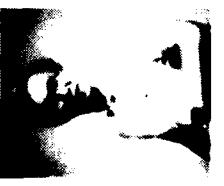
Finally, the fourth thrust will involve the specification, development, and/or integration of "what if" models into DIMIS. These models will help enlisted personnel managers assess the impact of alternative policy scenarios (e.g., promotion policies) on the size and composition of the enlisted force.

The inventory projection and data retrieval capabilities of DIMIS will support OP-01 in all aspects of enlisted personnel planning and managing. The specific areas that DIMIS will support include advancement planning, bonus policy development, and the management of skill communities.

Enlisted Personnel Allocation and Nomination System (EPANS)

Principal Investigators:

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Theodore Thompson
(619) 553-7959



optimization models. Measures of success include faster and less labor-intensive personnel actions, better decisions in terms of minimizing the imbalance in personnel assets among the fleets, and the ability to maximize individual location preferences.

An Enlisted Personnel Allocation and Nomination System (EPANS) has been developed for non-rated personnel (Seaman (SN), Airman (AN), and Fireman (FN) apprentices), and for Administrative/Deck/Supply ratings. In FY87, models for these ratings were installed for test and evaluation at the Naval Military Personnel Command (NMPC). EPANS matches people to jobs in accordance with multiple criteria, including fleet balance, PCS cost minimization, and individual geographic location preference. In FY88, EPANS was installed at NMPC for 28 additional ratings. As a result EPANS will be able to make 50 percent of the enlisted assignments for NMPC and the Enlisted Personnel Management Center. Future plans call for the expansion of EPANS to make 90 percent of all enlisted assignments and for the development of EPANS enhancements, including PCS budget constraints and en route training policy goals.

Until now, the Navy personnel assignment system has been basically a manual process. Deficiencies in this process can be attributed to (1) the lack of efficiency in terms of time and cost, (2) the inability to identify all possible assignments and select the best one, and perhaps most serious, (3) the inability to execute multiple assignment policies properly. Persistent problems due to inventory/billet mismatches, tight permanent change of station (PCS) budgets, and constraints imposed by existing assignment policies require improved systems to guide the distribution and assignment of personnel.

The objective of this effort is to develop a computer-assisted system for enlisted personnel assignment. This system would improve the effectiveness of enlisted assignment through the application of large-scale, multiple-criterion

Liang, T., & Bucklin, B. B. (1988). *Improving the utilization of training resources through optimal personnel assignment in the U.S. Navy*. *European Journal of Operational Research*, 33, 183-190.

Liang, T., & Bucklin, B. B. (1988). *Optimizing en route training in enlisted personnel assignment* (NPRDC TN 88-16). San Diego: Navy Personnel Research and Development Center.

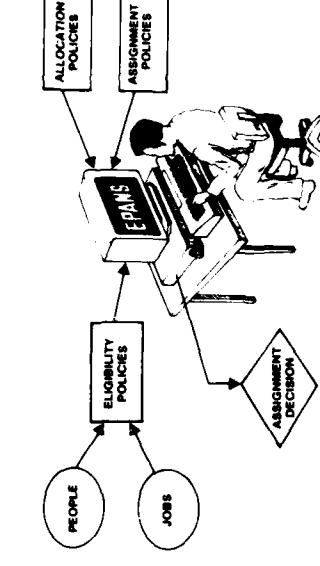
Liang, T., & Thompson, T. (1987). *A large-scale personnel assignment model for the Navy*. *Decision Sciences*, 18(2), 234-249.

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Thompson, T. (1988). *Evaluation of assignment policies using optimization models* (NPRDC TR 88-12). San Diego: Navy Personnel Research and Development Center.

Thompson, T. (May 1987). *Issues in the development of personnel assignment models for the Navy*. Paper presented at ORSA/TIMS Joint National Meeting, New Orleans, LA.



Krass, I. (1987). *An alternative algorithm for optimizing personnel assignment in the Navy* (NPRDC TR 87-35). San Diego: Navy Personnel Research and Development Center.

Liang, T. (1984). *Network formulation of multiple-criterion problems for developing an integrated personnel distribution system in the Navy* (NPRDC TR 84-49). San Diego: Navy Personnel Research and Development Center.

Officer Distribution Management System (ODMS)

Principal Investigator:

Yuh-Ling Su
(619) 553-8041



The Navy has a scarcity of officers in certain grades, warfare designators, and subspecialty skills. Careful consideration must be given when allocating these scarce resources among competing requirements. While officer Manning in the fleet is 100 percent, severe shortages exist on shore. Each officer community manager is faced with filling billets within the warfare community in addition to those that cross community lines (e.g., subspecialty billets). The current officer allocation process lacks timely, accurate information to assist in resolving conflicts in shore Manning priorities.

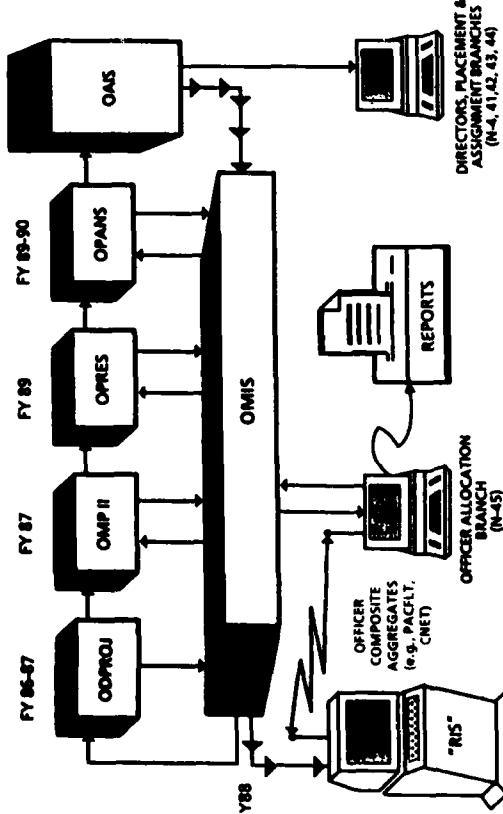
The purpose of this project is to develop an automated Officer Distribution Management System (ODMS) to project and allocate the available personnel inventory to officer billet requirements by grade, skill, and claimant. The major functions of ODMS include projection, allocation, billet "gapping," and system monitoring. This system will allow the Navy to achieve improved skill utilization, a better balance of officer assets among Navy activities, and a more accurate assessment of policy.

In FY86, the Officer Distribution Projection (ODPROJ) System was completed and installed on computers at the Naval Military Personnel Command (NMPC). ODPROJ projects next year's available inventory, first using the Officer Master File (OMF) and Billet File Special Extract (BFSE) to produce a current manning estimate, and then simulating inventory movement (e.g., promotions, losses) over the projection time frame. An initial version of a user interface system, called MONITOR, was also developed. A prototype of a new Officer Manning Plan (OMP II) was designed, installed, tested, and validated in FY87. OMP II allocates the rotating inventory by skill, grade, and CNO manning priority. Output is by activity composite (i.e., ships, squadrons) and fair-shared over Officer Composite Aggregates (OCAs) and individual activities' Unit Identification Codes (UICs).

In FY88, modifications and improvements have been made in this module as well as in the first module (ODPROJ). Additionally, plans have been developed to share selected online activity/manning information with the OCAs by developing a third module, the Officer Manning Information System (OMIS). It will be installed and tested in CINCPACFLT in the near future.

Future plans include the Officer Personnel Requisition System (OPRES) and the Officer Personnel Assignment and Nomination System (OPANS). OPRES will integrate the OMP II allocation plan with near-term projections of available officers and authorized billets to produce postings of job vacancies. OPANS is the final planned subsystem and perhaps the most challenging. As the actual selection of an individual to fill a billet nears, increased human judgment is required. OPANS will attempt to maintain a support role in this vital decision process by providing planners and assignment officers with a "nomination" for assignment. ODMSS will eventually be expanded to include all active duty officers, including the restricted line and staff corps.

Whisman, A., & Ganeshan, J. (1986). Officer distribution projection system: Prototype development (NPRDC TR 86-25). San Diego: Navy Personnel Research and Development Center.



Sea/Shore Rotation Management System

Principal Investigator:

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the most credit would be the first to rotate to maintain required readiness levels at sea, shore, or overseas by filling vacancies created by attrition, promotion, and prior rotation.

The objective of this project is to develop an integrated system, the Sea/Shore Rotation Management System, to support the Chief of Naval Operations (OP-01) and the Naval Military Personnel Command in rotation management. The system will consist of a rotation crediting index system; a flow model to determine the future (9 to 24 months) placement of inventory for sea, shore, and overseas billets; supporting data bases, data retrieval/reporting capabilities; and integrated "what if" models to allow rotation

In an ideal situation, every enlisted person in the Navy would rotate between sea and shore duty every 3 years. Under the present system, sea tours can range from 3 to 5 years. The problem stems from the fact that the number of sea billets greatly exceeds the number of shore billets. Also, there are personnel shortages in sea intensive ratings or specialties. There are also personnel who are in transit, in training, or who are patients. Manpower planners must compensate for these shortages with available personnel. Because sea billets take priority over shore billets, sea tours are extended and shore tours are shortened. Enlisted personnel who have been given tours with fixed tour completion dates are discontented with the changes.

The Navy Inspector General has recommended accelerated development of a vacancy-driven rotation system, the Navy Enlisted Personnel Rotation System (NEPERS), which can effectively place future inventories where they are needed to maintain readiness. NEPERS does not require fixed tours, but advocates a fair and equitable system of awarding rotation credit, recognizing the arduous nature of duty at sea and on foreign soil. Individuals with

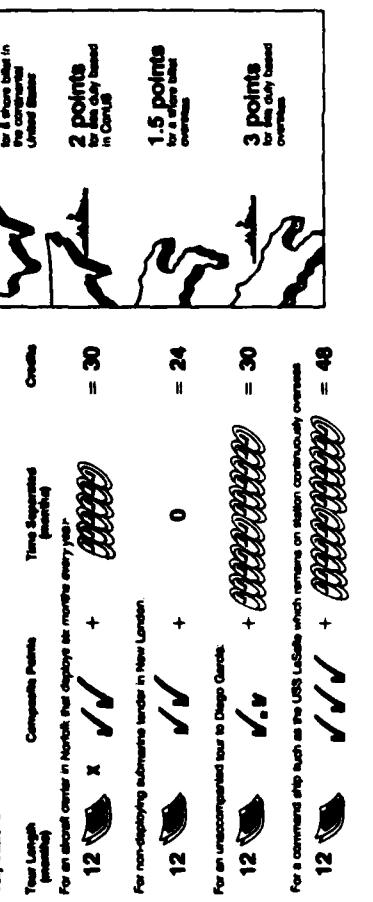
managers to quickly assess the effects of alternative tour length patterns on composite inventory goals.

In FY88, a comprehensive conceptual design was developed for the NEPERS rotation credit model. By the end of the fiscal year, data analysis was completed for the three pilot ratings: Aviation Antisubmarine Warfare Technician (AX), Boiler Technician (BT), and Cryptologic Technician Maintenance (CTM). In FY89, prototype models will be developed for these ratings and a validation survey of enlisted members will be conducted to refine the NEPERS credit system.

P.E. 0604703N

The Proposed Sea-shore Rotation System How It Might Work

Shore tours accumulate "credits" at each duty station. The more credits earned, the higher a sailor's chances of getting a choice assignment when he or she becomes eligible to rotate. A "key factor in the formula for calculating credits would be the composite pattern" (dashed at right). These would be multiplied by tour length (in months) and added to the time separated from family or deployed at sea (in months). Below are some examples of how credits would be earned during a year at various duty stations.



Permanent Change of Station (PCS) Impact System

The PCS Impact System will be used to justify the overall PCS budget to Congress, to quantify impacts of insufficiently funded PCS programs in terms of fleet manning imbalances, reduced readiness, and to meet military personnel assignment location preferences.

Principal Investigators:

Theodore Thompson

Iosif Krass

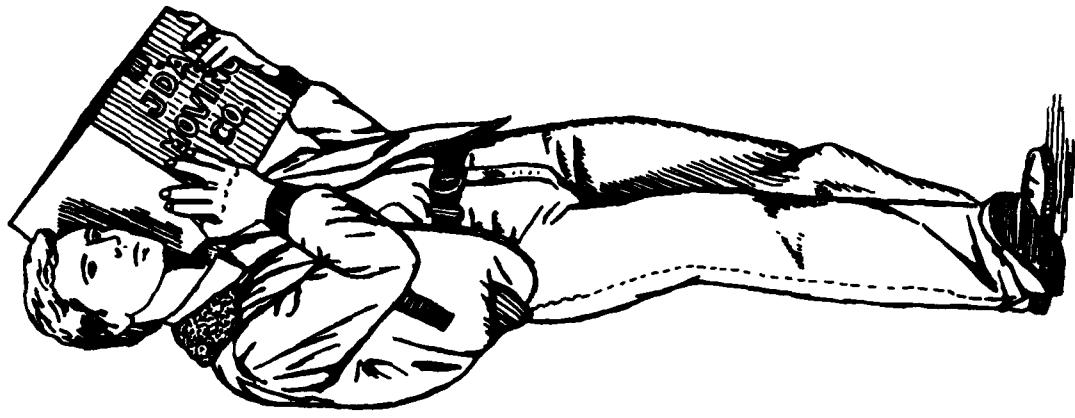
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P.E. 0603707N

Due to operational, rotational, and training needs, the Navy moves a large number of its military personnel from one station to another every year. The Navy spends up to \$600 million a year on military personnel moves. Every year the Navy has difficulty justifying its overall PCS budget submission to Congress, because it cannot quantify the impact of a PCS budget cut.

The purpose of the PCS Impact System is to investigate and develop criteria to quantify the impact of alternative PCS budget levels. Using multiple criterion optimization methods, a model will be developed that can control and maximize the utilization of a PCS budget by taking into account alternative assignment policies and evaluating tradeoff among policies. The system could be used to better manage and more effectively execute a given PCS budget, and, in the long term, formulate more defensible future PCS cost estimates.



Applications of Personnel Systems

Accession Supply Systems



Selection and Classification

Career Development Systems



Evaluation and Survey Systems



Personnel Function and Product Line Descriptions

Accession Systems	<p>Develops systems and procedures for recruiting, selecting, classifying, and utilizing officer, enlisted, and civilian personnel to improve performance and retention. Serves as the Chief of Naval Operations primary personnel survey resource to coordinate and conduct attitude surveys in the Navy and Marine Corps and to develop new survey technology.</p>
Accession Supply Systems	<p>Accession Supply Systems--Designs systems to enhance the Navy's capability to attract appropriate supply of military accessions in terms of number, characteristics, and availability under differing social and economic conditions.</p>
Selection and Classification	<p>Selection and Classification--Develops systems to predict military performance and tenure and to establish standards for school/job entry.</p>
Career Development Systems	<p>Career Development Systems--Develops systems to analyze and develop policies and procedures that maximize the utilization of personnel throughout their careers.</p>
Evaluation and Survey Systems	<p>Evaluation and Survey Systems--Develops systems to evaluate the effectiveness of quality of life programs and to improve the quality of personnel survey data.</p>

Armed Services Applicant Profile

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The U. S. Congress and the Government Accounting Office (GAO) have requested an improvement in the personnel quality indicators that define enlisted selection standards, including a reduction in the general reliance on a high school diploma as a discriminator. NPRDC has been tasked by the Office of the Assistant Secretary of Defense (Force Management and Personnel) as lead laboratory in the development of a joint-service adaptability screening instrument.

The global objective of this project is to improve enlisted personnel screening by differentiating applicants in terms of their potential adaptability to military service. The specific objectives are to: (1) develop a self-report biographical questionnaire that can be used by all services, (2) validate the instrument against a completion of service criterion, and (3) incorporate adaptability screening into the existing recruiting and examination systems.

Two experimental versions of the Armed Services Applicant Profile (ASAP) were constructed and administered to a national sample of 200,000 armed forces applicants. Of this group, 55,675 active duty accessions from the applicant

cohort were tracked through their second year of service. ASAP item responses were compared between service completers and attrites to develop a scoring key. Cross validation in an independent sample demonstrated considerable incremental validity of the ASAP in relation to existing military enlisted selection standards (high school diploma and Armed Forces Qualification Test (AFQT). If the ASAP was used to augment the enlisted selection system, the magnitude of this enhanced precision in prediction would increase the annual number of 36-month service completions by 3,000 or more.

A more specific application would employ the ASAP to identify low attrition-risk individuals from high attrition-risk groups (alternative high school credential applicants and AFQT category IV applicants) in order to increase the numbers of qualified personnel.

Work completed in FY88 was concerned with (1) the problem of item response distortion of self-reported biodata, (2) the problem of test bias against protected groups, and (3) the development of software for a computer-administered version of the ASAP.

During FY89, the ASAP will be readied for operational use in FY90. An adaptability pre-screen for recruiting level administration will be developed in FY90.

Reimbursement

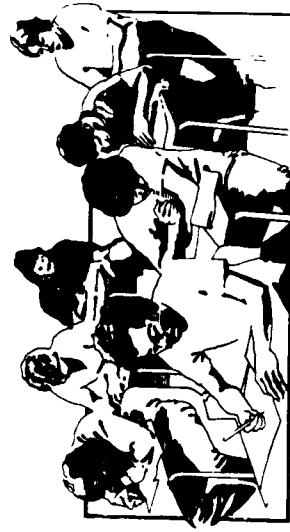
Report:

Trent, T. (in press). *Joint service adaptability screening: Initial validation of the Armed Services Applicant Profile (ASAP)* (NPRDC TR 88-8). San Diego: Navy Personnel Research and Development Center.

Trent, T. (1987). *Armed forces adaptability screening: The utility of the biographical inventory*. Paper presented at the Annual Convention of the American Psychological Association, New York, NY.

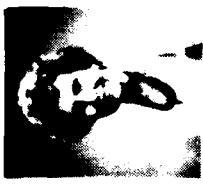
Trent, T. (1987). *Armed forces adaptability screening: The problem of item response distortion*. Paper presented at the Annual Convention of the American Psychological Association, New York, NY.

Trent, T., Atwater, D. C., & Abrahams, N. M. (1986). *Biographical screening of military applicants: Experimental assessment of item response distortion*. *Proceedings of the Tenth Symposium Psychology in the Department of Defense (USAFA TR-86-1)*, 96-100.



Integrating Officer Selection Systems

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longitudinal officer research data base. The data base includes applicant selection data, training performance records from the Naval Academy and Naval Reserve Officer Training Corps (NROTC) colleges, and officer performance measures throughout the officer's career.

The Naval Academy data set has been in existence for many years and continues to be used to refine the selection system and to develop and validate new procedures and instruments. Recently, it was expanded to include officer fitness report information and improved software procedures for data handling and retrieval were added. This data base is made available to selected contractors and university-based researchers to conduct approved research in support of project goals.

Substantial resources are invested in recruiting, selecting, and training Navy officer candidates in each of a number of separate programs. Additional resources are invested in developing those candidates who receive officer commissions. Failure to select initially those candidates most likely to become effective career officers results in considerable waste of individual as well as Navy resources. Because of past limitations in data availability, the officer selection system has focused on identifying those who will do well in training. The emphasis in officer selection must expand to include selection for career performance.

The work in this task is driven by the need to make the officer candidate selection system as effective and responsive as possible in the face of resource limitations and continual changes in the personal attributes and quantities of available personnel. The problem being addressed may be characterized as the need to develop and refine procedures for improving prediction of an individual's military and occupational tenure and suitability.

An accomplishment of far-reaching consequence has been the development of a

procedure. Based on these reviews a major contractor effort began in FY88 with the aim of making significant reductions in program attrition.

In FY89, the medical scholarship selection program will be investigated as this task expands toward its goal of integrating officer selection systems. As a first step, a thorough review of current procedures and selectors will be conducted and the problems defined. This process will culminate with a research design for implementation in FY90.

PE.0602234N

Reports:

Borman, W. C., Owens-Kurtz, C. K., Peterson, V. A. & Matson, J. D. (in press). Attrition from NROTC: A review and critical analysis of the issues. San Diego: Navy Personnel Research and Development Center.

Matson, J. D., & Abrahams, N. M. (in press). Preliminary evaluation of a personnel history questionnaire for predicting Naval Academy voluntary motivational disenrollment. San Diego: Navy Personnel Research and Development Center.

Matson, J. D., & Abrahams, N. M. (1986). Development of a revised composite for NROTC selection (NFRDC TN 87-7). San Diego: Navy Personnel Research and Development Center.

Neumann, J., Alf, E. F., Jr. & Matson, J. D. (in press). Review of the United States Naval Academy selection composite. San Diego: Navy Personnel Research and Development Center.

Neumann, J., Matson, N. M. (in press). Development and evaluation of an officer potential index. San Diego: Navy Personnel Research and Development Center.

Owens-Kurtz, C. K., Borman, W. C., & Peterson, V. A. (1987). Voluntary turnover: A review of the literature (Institute Report No. 130). Minneapolis: Personnel Decisions Research Institute.

U.S. Naval Academy Midshipmen Selection

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data are added at the end of each semester for the four current classes. Finally, to permit the evaluation of selection procedures and their effectiveness in predicting the retention and performance of Naval Academy commissioned officers, information is extracted annually from the officer master, attrition, and fitness records.

The second phase covers the validation of the current selection procedures as well as the preparation of the tables, charts, and figures to communicate the results of the Naval Academy selection board.

The cost and difficulties of recruiting, training, and retaining high quality, technically oriented career officers continue to escalate. The total cost of educating and training each midshipman commissioned by the Naval Academy has grown from an average of \$76,000 in 1975 to current costs exceeding \$140,000. Clearly, it is important to select Naval Academy midshipmen likely to graduate and contribute effectively as naval officers.

Previous research and development efforts provided empirically based procedures for selecting Naval Academy midshipmen. The objective of this effort is to provide the necessary support to monitor and maintain the effectiveness of those selection procedures now that they have been implemented.

This effort proceeds in two phases: The initial phase covers the updating of the Naval Academy data base. First, selection scores, test data, and demographic information are added to the data base for each incoming class. Second, criterion information (performance measures), such as grades, choice of major, and attrition

query the system online to locate any data sets within the Naval Academy data base, (3) documentation of the entire system is proceeding for both the online and hard-copy versions, (4) validation of current selection procedures as of June 1987, (5) presentation of results to the Naval Academy Dean of Admissions, and (6) providing assistance to the Academy in implementing any changes to the selection composite and the selection procedures in general.

Plans for FY89 include: (1) Continue to refine, enhance, and update the newly-designed Naval Academy data base, (2) update the four current classes in June 1988 and install the Class of 1992 data into the system, (3) validate current selection procedures as of June 1988, and (4) provide assistance in implementing procedural changes for selecting the Class of 1993.

Reimbursable



Equal Employment Opportunity (EEO) Enhancement

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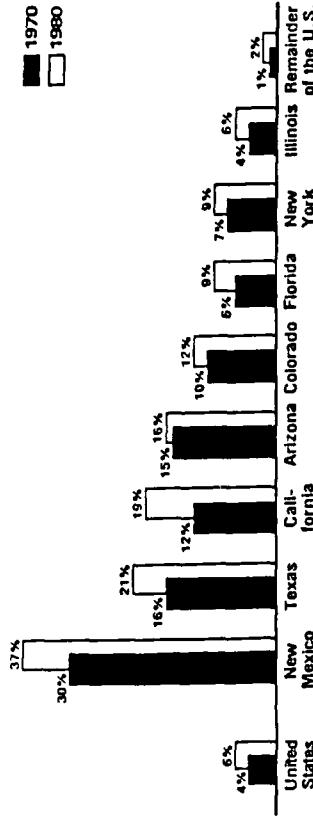


In an era of declining numbers of working age adults, Hispanics and women are an underutilized resource in various Navy civilian occupations. This situation represents a problem because Federal law requires that the work force be representative of the nation's diversity, and because resources spent on processing discrimination complaints should be diverted to other Navy priorities.

The objective of this project is to investigate the cause of underrepresentation of Hispanics and the problems associated with integrating women into nontraditional jobs.

The project is being conducted in two phases. Phase 1 consists of problem definition. Through interviews of key EEO personnel and surveys of supervisors, insights into the causes of the problem, efforts to address the problem, and opinions concerning implementation of the EEO program were gathered at selected Navy activities. Phase 2 is the data gathering stage. Organizational, individual, and social variables that are hypothesized to contribute to the problem are being investigated.

Percent Spanish of Total Population by Area



During FY86, Phase 1 was completed. As a result of this effort, situations that need to be corrected were identified and staffed for action by the Navy. In addition, the research design was expanded to include an investigation of unanticipated variables that may be contributing to EEO issues involving Hispanics and women in nontraditional jobs.

Phase 2 began during FY87 and is continuing into FY90. To investigate individual and social variables, a sample of civilian personnel is being selected. This sample consists of Hispanics and women entering Navy blue-collar jobs who complete a survey of their background, attitudes, and expectations. One year later, or when they leave the job, a second survey will be administered to members of the sample and their supervisors. Organizational variables at sites where these workers are employed were investigated in FY88. In addition to this tracking effort, data has been gathered concerning several issues that may be contributing to the underrepresentation of Hispanics. These data include test scores of Hispanic and other women applying for clerical positions, and the self-identification of race and ethnic group using two different forms.

As a direct consequence of this project, a recommendation to consolidate three previously separate personnel forms into one was accepted at the Assistant Secretary of the Navy level and will eventually be implemented.

In FY89, data collection will continue and a number of interim reports will be issued. An experimental method to improve the quality of SF-171s through the use of an instructional videotape will be evaluated.

P.E. 0603707N

Reports:

Edwards, J. F. (1988). *Work outcomes as predicted by attitudes and demographics of Hispanic and NonHispanic: A literature review*. (NPRDC TN 88-23). San Diego: Navy Personnel Research and Development Center.

Lunichborg, P. W., Kellman, Vowell, K., & Srobnik, D. C. (1988). *Turnover of women in nontraditional skilled crafts: A literature review*. San Diego: Navy Personnel Research and Development Center.

Thomas, P. J. (1987). *Hispanic underrepresentation in the Navy's civilian work force: Defining the problem*. (NPRDC TN 87-3). San Diego: Navy Personnel Research and Development Center.

Lost Time of Men and Women

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There are three major objectives for this effort. The first is to investigate the total amount of time lost due to pregnancy so that the impact of pregnancy on various Navy systems can be determined. It will also be necessary to establish the lost time of women who are not pregnant and of men to provide a comparison so that meaning can be attached to the pregnancy statistics. The second objective is to investigate the impact of pregnancy on ships and deploying aviation squadrons. This phase of the project will focus on readiness and sea/shore rotation policies in submarine/destroyer tenders, VP/VQ squadrons, and shore commands where women are concentrated. The third major objective is to

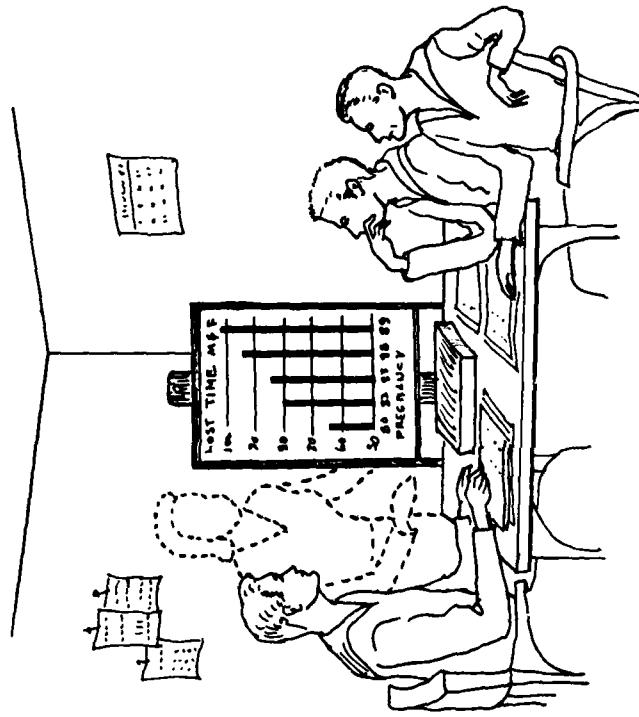
investigate the intrusiveness of single parenthood and pregnancy upon the Navy as reflected by the need for preferential treatment, requirement for special assignment policies, or strategies for dealing with problems associated with these conditions.

FY88 was devoted to conducting and analyzing the Navy-wide survey of enlisted men and women, designed to establish base rates for pregnancy and single parenthood. Plans for FY89 include an analysis of lost time for enlisted men and women and the acquisition of data describing the impact of pregnancy on individual commands.

P.E. 0603707N

In the past 15 years, the representation of women in the Navy has grown from 2 to almost 10 percent of the force. Greater utilization of women has resulted in new personnel issues, none of which is more thorny or emotional than pregnancy. In addition, issues associated with families, that the Navy had not fully addressed with a predominately male force, are becoming more intrusive. Single parenthood, for example, is frequently cited as being of growing concern to the military. Both pregnancy and parenthood become personnel problems when they impact on flexibility of assignment, require special services, result in undue absenteeism, and impact on operational readiness.

This project represents a new start in FY88. As a first step in investigating the problems associated with pregnancy and single parents, the number of personnel involved must be determined. A stratified random sample of enlisted women and men will be surveyed to develop these statistics by pay grade, rating type (sea- vs. shore-intensive), and location (CONUS vs. overseas). Because of its anonymous nature, the women's survey will include additional questions of a personal nature that address sensitive issues.



Cognitive Process Assessment

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impact, both in terms of monetary costs and fleet readiness.

The validity of aptitude tests can be improved by examining the processes by which the examinee arrives at an answer, not just the final answer itself. Information about the cognitive processes can often be obtained by presenting the item in stages, and timing each stage. For example, with computerized presentation of aptitude test items, the text of the item can be presented on one screen, the question on a second screen, and the answer alternatives on a third screen. By requiring the examinee to press a key to see the next screen, each stage of the solution process can be timed. Several research studies suggest that individuals who spend relatively greater amounts of time understanding the problem and shorter times looking at alternatives, perform better in school and on the job.

Congress is concerned with reducing personnel costs, improving job performance, and making better use of minorities and non-high school graduates. The services use tests (e.g., the Armed Services Vocational Aptitude Battery (ASVAB)) to select and classify personnel for specialized training. Existing tests predict about 25 percent of the variance in school or job performance. Better aptitude tests are needed that are: (1) relatively independent of a person's acquired knowledge, (2) better measures of a person's true potential, and (3) better predictors of job performance.

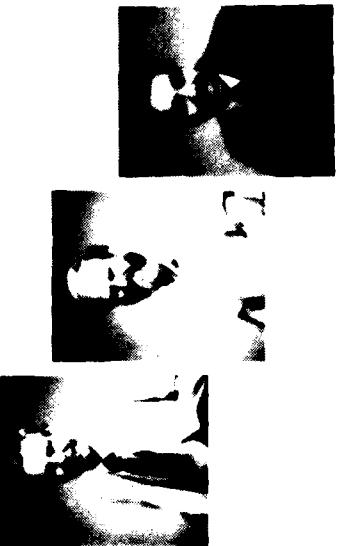
A recent study was completed for NPrDC that was designed to determine how much increase in validity over the ASVAB could be attained by adding new predictors, and what the utility would be of such a validity improvement. It was estimated that validity could be increased by at least 3 percent (e.g., a validity increased from .59 to .61) and that would result in the equivalent of \$83 million annually in performance improvement in the Navy. The savings occur because the additional validity will result in assignment of more effective personnel. Thus, increased test validity could have a large



P.E. 06022234N

Personnel Distribution and Career Development

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Interviews and questionnaires are being used in a repeated-measures, multiple-cohort design to examine the Navy careers of O-1 to O-5 unrestricted line (URL) personnel. All personnel who participated initially (Time 1) have been followed up 4 years later (Time 2) to obtain information on developmental change and generational differences in each group. Subsamples have been selected and assessed in interim years to develop operational data on unique factors. Special attention is focused on increasing the effectiveness of formal and informal career advisors in career decision-making, including retention, and also on identifying the critical points in the career when decisions are made.

A conceptual model was developed and tested regarding the factors influencing general unrestricted line officers (GenURLs) and surface warfare officers (SWOs) perceptions of their assignment officers. Based on interview and Time 1 questionnaire data, a recommendation was made and adopted that GenURL reassign the officers from their own community. Previously, SWOs detailed the GenURL community. At Time 2 the GenURL officers' perceptions of their detailers had improved significantly.

The Navy is experiencing shortages in the officers qualified to command major sea and shore activities. The decrement is also becoming critical among more junior career personnel and those who are required to have advanced technical abilities.

The primary objective of this project is to identify the personnel and organizational factors that encourage high-quality commissioned officers not only to make the Navy their career, but also to acquire the skills essential to performing well in senior billets. A subordinate objective is to modify, develop, and evaluate personnel distribution and career development programs that aid the accomplishment of Navy requirements for quality officer performance.

provided repeated-measures data. They produced data on the current career management problems of the Navy related to the three officer communities addressed by this research. A questionnaire has also been sent to approximately 5,000 other officers on career transition issues. Interviews have been conducted in the three officer communities to supplement questionnaire results and to serve as immediate feedback to Washington on the impact of recent policy initiatives. Recommendations were made and briefings completed on officer community management policies and practices. An analytical methodology was developed to test the career development model.

In FY88, prototype models of officer upward mobility and professional development were developed.

P.E. 0602233N

Reports:

Habel, M. D., Wei, E. K., & Habel, L. (June 1988). *The analysis and clustering of Navy ratings based on social interaction characteristics: A literature review and conceptual model* (NPRDC TN 88-46). San Diego: Navy Personnel Research and Development Center.

Morrison, R. F. (March 1988). *Officer career development: URL officers in joint-duty assignments* (NPRDC TN 88-26). San Diego: Navy Personnel Research and Development Center.

Morrison, R. F., & Cook, T. M. (1986). *Military officer career development and decision making: A multiple-cohort longitudinal analysis of the first 24 years* (NPRDC MPL TN 85-4). San Diego: Navy Personnel Research and Development Center.

Murphy, K. R. (April 1988). *Dimensions of job performance ratings: A preliminary study* (NPRDC TN 88-35). San Diego: Navy Personnel Research and Development Center.

Wilcove, G., Bruni, J. R., & Morrison, R. F. (1987). *Officer career development: Reactions of two unrestricted line communities to detailers* (NPRDC TN 87-40). San Diego: Navy Personnel Research and Development Center.

Wilcove, G., Bruni, J. R., & Morrison, R. F. (1987). *Officer career development: Reactions of two unrestricted line communities to detailers* (NPRDC TN 87-40). San Diego: Navy Personnel Research and Development Center.

Marine Corps Decision Support System for Officer Assignment

Principal Investigator:

Robert Chatfield

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of the officers being assigned, and job dimensions of available billets. Because of multiple data elements and the number of alternatives inherent in the assignment process, monitors need support in decision-making. A user-friendly, interactive decision support system, based on reliable information, would assist monitors in implementing U. S. Marine Corps (USMC) staffing policy and in enhancing the person-job match.

The objective of this effort is to develop a decision support system (DSS) for officer monitors that includes relevant, reliable information about both officers and billets. As an adjunct to the DSS, monitor-oriented training materials and procedures will be developed and implemented.

The approach involves evaluating data elements required by monitors to make assignments and capturing their decision-making rules. A variety of other factors affecting the assignment process will be investigated as well. USMC manpower experts will judge the criticality of existing and proposed data elements and levels of information contained in them. Based on these judgments, new data elements will be established, relative values attached, and a DSS developed. Prototype "modules" (subsystems) of this Officer Assignment Decision Support System (OADSS) will be pilot tested for adaptability, effectiveness, and acceptance.

The task of Marine Corps officer monitors is to simultaneously accommodate the needs of the Corps and the desires of the individual officers in the assignment process. Performance of this task requires consideration of the skills and attributes

Automated Information Systems (LCM-AIS), including a Requirements Statement, a combined Feasibility Study/Economic Analysis, a Project Management Plan, a combined Functional Description/Data Requirements Document, and a combined General Design Specification/Detailed Design Specification. Microcomputer-based Versions 1.00 and 2.00 of the Special Education Program (SEP) module have been completed and the latter is operational at HQMC. In addition, at the request of the USMC Deputy Chief of Staff for Manpower, a prototype General Officer Assignment Location System (GOALS) (Module 2) was developed to manage the general officers' population. Version 1.00 of GOALS has been installed in the Personnel Management Division at HQMC and is undergoing operational testing.

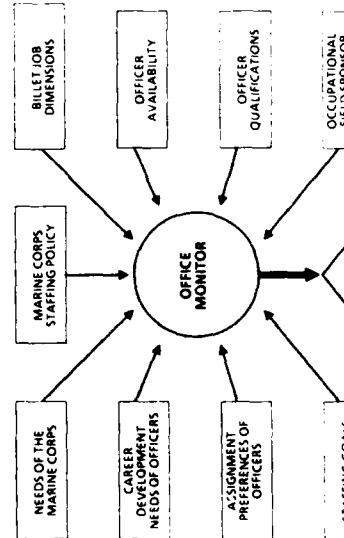
Work completed in FY88 included development, installation, and operational testing of the Annual Slate Letter (ASL) and Field Access to Constituent Data (FACD) prototype subsystems. Plans for FY89 will include development of an Automated Monitor Orientation System (AMOS) prototype, improving access to personnel data bases, and transitioning OADSS prototypes to full-scale operation within HQMC.

P.E. 0603732M

Report:

Chatfield, R. E. (in press). Development of a USMC officer assignment decision support system: Feasibility study and economic analysis. San Diego: Navy Personnel Research and Development Center.

Chatfield, R. E. (in press). Development of a USMC officer assignment decision support system: Needs assessment. San Diego: Navy Personnel Research and Development Center.



Accomplishments to date include extensive interviewing of Headquarters, Marine Corps (HQMC) Officer Assignment Branch personnel and an analysis of the decision-making process; evaluation of existing data elements for their relevance and reliability, and proposal of new data elements for DSS inclusion; submission of system definition and design documents in compliance with the USMC Life Cycle Management for

Classification and Assignment Within PRIDE (CLASP) System Development

Principal Investigator:

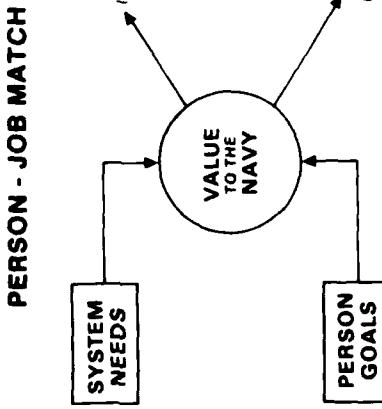
Leonard Kroeker
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Since 1981, the Navy has used an automated classification system to assign non-prior service male and female applicants to entry-level Navy jobs. The system yields a list of potential assignments ordered on the basis of person-job match quality. A recruit applicant is encouraged to accept the top job on the list so that Navy objectives and, to a lesser extent, personal objectives are maximally satisfied.

Actual assignments are often the result of a compromise between classifier and applicant. The applicant has not completed the enlistment procedure (i.e., joined the Navy) during classification and, as a result, he or she may bargain effectively for a desired assignment near the bottom of the list at the Navy's expense. Assignments at or near the top of the classifier's list of available jobs are clearly in the Navy's best interests.

This project reviews the enlistment transactions, analyzes the performance of the CLASP assignment procedure under the constraints of operating conditions, and prepares updated model parameter values. Revised parameter values are needed to ensure that the model is able to meet changing policy requirements or changing personnel quality levels.



reflecting the value of particular person-job assignments from perspectives other than those currently used.

For maximum benefit to the Navy, a new component that includes job performance information must be designed so that it exhibits interaction between person attributes and job properties. The component will reflect the following Navy managerial requirements:

- (1) The utility of a higher performing person always exceeds that of a lower performer when both are considered for the same job,
- (2) the utility of a high performer increases as the criticality level of the job increases, and
- (3) the variance of the optimal indices and person-job match quality for a job at the high end of the criticality scale exceeds the variance at the low end. In FY88, CLASP output statistics have been used as effective devices to identify and correct future recruiting shortfalls. This development continues into FY89 and beyond.

Reimbursable

Reports:

Kroeker, L. P. (in press). *Extending the Navy classification model*. In S. Wigdor and B. Green (Eds.), *Proceedings of the National Academy of Sciences: Meetings on the performance of military personnel*, Santa Fe, NM.

Kroeker, L. P. (in press). *Personnel classification/assignment models* (Chapter 2). In M. F. Wisthoff and G. M. Rampton (Eds.), *Military personnel measurement: Retrospect and prospect*. Praeger Scientific.

Kroeker, L. P., & Rafacz, B. A. (1983). *CLASP: A recruit assignment model* (NPRDC TR 84-9). San Diego: Navy Personnel Research and Development Center.

Job Performance Measurement Program

Principal Investigator:

Gerald Laabs
(619) 553-7640



include a prediction of job performance in the Navy's automated classification system, CLASP.

Other objectives include validation of new predictor tests against job performance and development of a prototype JPM data base. The use of new predictors will improve the capability of CLASP to match the person to the job, thereby enhancing job performance. A data base that includes performance measurement and prediction information will be useful to operational as well as research communities.

The effectiveness of the personnel system and, ultimately, performance in the fleet, can be greatly influenced by the personnel classification and assignment process. Although on-the-job performance is the most appropriate criterion for validating predictors used in this process, enlistment standards typically have been related to the easily obtained criterion of end-of-course grade. The Job Performance Measurement (JPM) Program supports a coordinated effort to investigate different performance measurement approaches and to meet a Congressional mandate to link enlistment standards directly to job performance.

It is generally recognized that hands-on tests yield the best performance information, but that it is too expensive to administer such tests on a routine basis in the military. One of the main objectives of the JPM Program is to develop economical substitute measures for hands-on tests, thereby providing the measurement capability required to

tests will be fielded and necessary steps will be taken to develop a prototype JPM data base.

Accomplishments to date include the preliminary selection of critical tasks for all ratings to be covered. Field test packages have been constructed for the first three ratings: Machinist's Mate, Radioman, and Electronics Technician. An Air Force package concerning jet engine mechanics also has been adapted for a technology transfer study. Fleet data collection has been completed for these three ratings and the technology study.

The approach to the JPM Program involves developing methodologies to measure job performance, establishing relationships between resultant performance data and new and existing predictors, assembling performance data into a multi-user data base, and finally, constructing a performance-based component for CLASP.

In the primary project of the JPM Program, Performance-based Personnel Classification, various performance measures will be developed with an emphasis on assessing technical proficiency using hands-on tests that are actual job samples. Field test packages will also include more economical measures of proficiency such as job-sample simulations and behaviorally anchored rating scales. Several types of job performance measures will be administered to fleet personnel in a minimum of eight ratings to investigate the use of simulations and rating scales as substitutes for the hands-on tests.

In the two other projects that are part of the JPM Program, both a Navy and a Joint-Service battery of new computerized ability

Data collection for the three ratings included the concurrent administration of the new Navy predictor battery. The new Joint-Service battery was also administered to the Electronic Technicians. Hands-on job sample tests were developed for the Electrician's Mates and the Fire Control Technicians. As an in-house technology transfer study, a field test package for the Gas Turbine Technician was assembled using several previously developed machinist and jet engine mechanic test items.

A Life Cycle Automation Management Plan for a JPM data base has also been completed, along with the first two steps in the Plan: an assessment of the need for JPM information and a functional requirements analysis for a JPM information system.

In FY89, the hands-on job sample test will be developed for the Operations Specialist. The field test packages will be completed for Electrician's Mates and Fire Control Technicians. Fleet data collection will be completed for these two ratings plus the in-house technology transfer study involving the Gas Turbine Technician. Both the

Navy and Joint-Service predictor batteries will be administered along with the job performance measures. Finally, a prototype JPM data base will be developed.

P.E. 0603707N

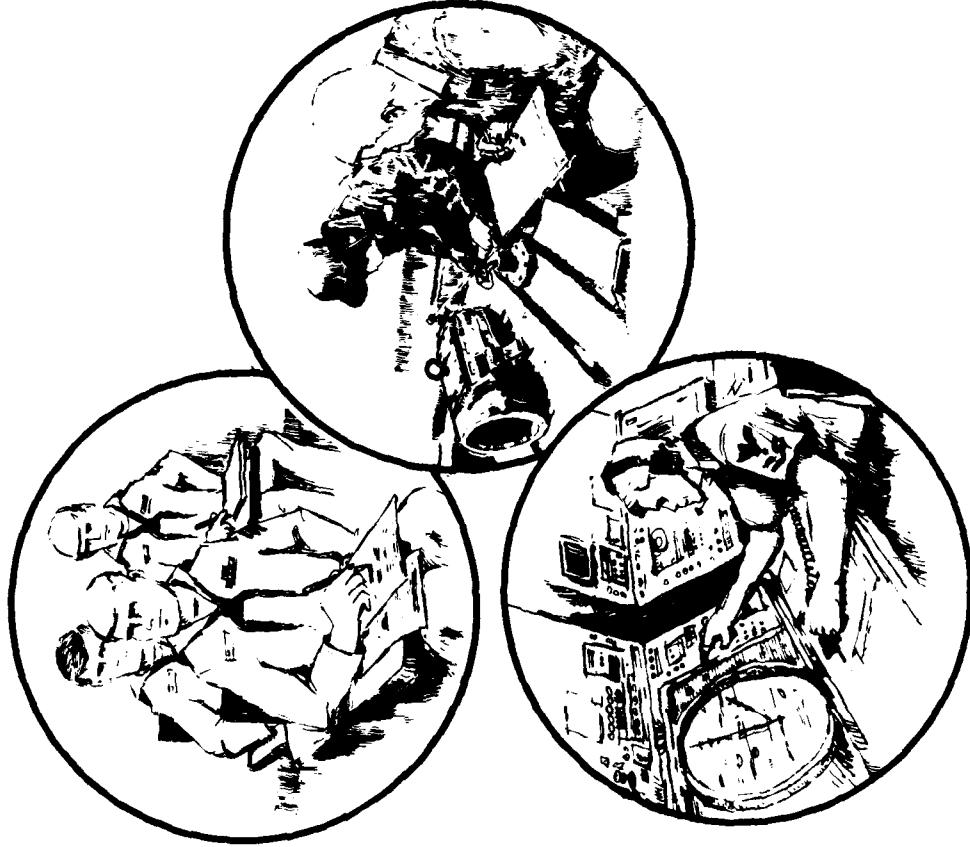
Reports:

Baker, H. G., Blackhurst, J. L., & Alba, P. A. (1987). *Interservice technology transfer of J-79 jet engine mechanic performance measures* (NPRDC TN 87-22). San Diego: Navy Personnel Research and Development Center.

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Laabs, G. J., & Berry, V. M. (1987). *The Navy job performance measurement program: Background, inception, and current status* (NPRDC TR 87-34). San Diego: Navy Personnel Research and Development Center.

Lammlein, S. E., & Baker, H. G. (1987). *Developing performance measures for the Navy radioman (RM): Selecting critical tasks* (NPRDC TN 87-13). San Diego: Navy Personnel Research and Development Center.



The JPM Program is assessments technical proficiency, in the fleet, using field test packages. These packages include hands-on tests, paper-and-pencil tests, and computer-based job samples.

Computerized Executive Networking Survey System (CENSUS)

Principal Investigator:

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effort is to develop, test, and implement a nationwide automated survey system for Navy civilians. Surveys responsive to policy makers' requirements will be administered on a periodic basis, responses integrated with existing computerized personnel data bases, and analyzed, providing rapid results.

The technological objectives of CENSUS are to improve survey design in the context of computer technology. Because microcomputer technology permits surveys to be administered and analyzed in an efficient manner, many survey design issues may be easily addressed. These include response effects (i.e., length and wording of questions) and response styles (i.e., social desirability and response strength). While these effects have been documented in the literature for traditional paper-and-pencil surveys, their effects have not been systematically studied in the context of computer technology.

One major problem facing policy makers in the Navy Civilian Personnel Command is the continual need to obtain timely and accurate information about the work force. What is required is the capability to gather attitudinal information about issues that affect the working lives of the 350,000 Navy civilian employees world-wide. Presently, opinions and attitudes of personnel are assessed in response to a specific situation or need using paper-and-pencil surveys mailed to a sample of civilians. Generally, by the time results are available, the reason for gathering the information is obsolete, and the data are out of date and no longer relevant. Clearly, what is needed is a system to gather attitudinal data that is fast, useful, reliable, and accurate.

CENSUS is being developed as an automated survey system that is cost-effective and affords policy makers timely and accurate information concerning attitudes of the civilian work force. The operational objectives of CENSUS are to administer, collect, code, analyze, and report results from attitudinal surveys in a timely and efficient manner. The overall objective of this

Accomplishments to date include conducting several successful field tests of both CENSUS and MASQ, and nationwide MASQ surveys. Information was used to support policy decisions in support of Deputy Assistant Secretary of the Navy (CPP/EEO) and Office of Civilian Personnel Management (OCPM). The CENSUS system has significantly reduced the error rate and extensive time delays associated with traditional paper-and-pencil surveys. In addition, equivalent scores on standardized job satisfaction and organizational communication scales have been obtained for both paper-and-pencil survey groups and MASQ and CENSUS survey groups. Respondents have consistently indicated that the computerized administration of surveys is more enjoyable than traditional methods of administration. Because of these quality and timely survey results, an implementation plan has been drafted for OCPM and recommendations are being considered to conduct operational CENSUS during FY89.

Future plans for CENSUS include completion of a MASQ manual for operational use, development of CENSUS to interface with the electronic communication system being utilized by OCPM, and the planning and establishment of a longitudinal data base of civilians to be surveyed on an ongoing basis. According to the implementation plan, operational surveys for OCPM will continue to be supported in the future with an emphasis on improving the quality of surveys through technology.

P.E. 0603707N

Reports:

Rosenfeld, P., Doherty, L. M., & Carroll, L. K. (1987). *Microcomputer-based organizational assessment: Applications to training*. *Journal of Business and Psychology*, 1(4), 419-430.

Survey Technologies

Principal Investigator:
Emanuel Somer
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Recent developments in computer capabilities and communications are enabling surveys to be designed, developed, administered, and analyzed quickly in a broad range of settings. By combining computer technologies with innovations in the fields of psychology (e.g., survey development and cognitive processing) and statistics (e.g., sampling theory and multivariate statistics), a completely automated survey system can provide policy makers with up-to-date reliable information on the impact of specific policies.

Navy policy makers are required to make decisions that significantly affect the personal and working lives of Navy personnel. What is needed is a fast, useful, reliable, and accurate method of gathering attitudinal data.

A current advanced development project, Computerized Executive Networking Survey System (CENSUS), is a microcomputer-based quick reaction survey feedback system that administers and analyzes questionnaires, providing policy makers with up-to-date reliable information on the impact of specific policies on the quality of life for Navy civilians. The overall objective of these two efforts is to develop a stand-alone automated survey system that encompasses all aspects of survey design, administration and analyses.

Several critical, yet missing, technology-based issues need to be resolved to develop a stand-alone automated survey system. These are (1) evaluating different questionnaire and format designs based on human information processing models, (2) assessing reliability and validity of computerized surveys, and (3) developing automated sampling strategies that address salient variables of Navy populations.

basis of a survey primer for unsophisticated survey sponsors is underway. These include: (1) orientation to surveys and their use, (2) sampling, (3) questionnaire design, (4) measurement, (5) analyses, (6) data bases, and (7) interpretation of surveys. Sampling strategies for Navy populations is currently being developed that may result in management tools. Experimental work on variables related to the reliability/validity issues of response "truthfulness" have been conducted.

The approach for each of the four components is as follows:

1. Questionnaire and format design will be tested by assessing how the context or format of attitude items for different subject areas affects responses using human information processing models as a basis.
2. Unreliability stemming from the effects of the survey itself (e.g., length and wording of questions), interaction of the survey and respondent (e.g., computer technology), and the respondent (e.g., social desirability, etc.) will be studied in the context of CENSUS. Validity will be assessed by response confirmation on standardized instruments and interaction with the technology (e.g., honesty on computers versus traditional methods).
3. Automated sampling will be incorporated with CENSUS after technological issues of the impact of potential salient variables for the military (e.g., rotation) have been addressed and evaluated.

Future work includes: (1) field testing of graphical presentations of surveys, (2) developing and testing a computerized prototype algorithm that integrates sampling strategies into CENSUS, (3) field testing computerized instructional modules to train policy makers to use the system, (4) addressing reliability and validity of responses using computers, and (5) integrating the instructional modules to teach survey design with an archival data base of questions and evaluating that system in the context of the overall efficiency of the system.

P.E. 0002234N



Evaluation of the Navy's Consolidated Brig System

Principal Investigator:
Elyse Kerec
(619) 553-7866



weaknesses so that system managers can make informed decisions, and for measuring outcomes to determine if the system is meeting its goal of returning productive personnel to the fleet.

Standardized evaluation data will be incorporated in the Navy's Corrections Management Information System (CORMIS). Specifically, the evaluation will: (1) define factors with potential impact on prisoners, (2) specify criteria for "success" of the programs, (3) identify data to be collected (both process and outcome) and appropriate analyses, (4) establish requirements for institutionalizing an evaluation system, including reporting standards, and (5) design a system that identifies prisoner success and correctional process strengths and weaknesses.

Reimbursable

The Navy is in the process of revising its corrections programs, with the goal of restoring a larger percentage of prisoners to active duty following the completion of their sentences. Better methods for assessment and classification of offenders will be implemented, along with additional programs for rehabilitating those with the potential to be productive sailors. Three newly constructed consolidated brigs and eight renovated waterfront brigs will be better able to utilize limited personnel and professional services.

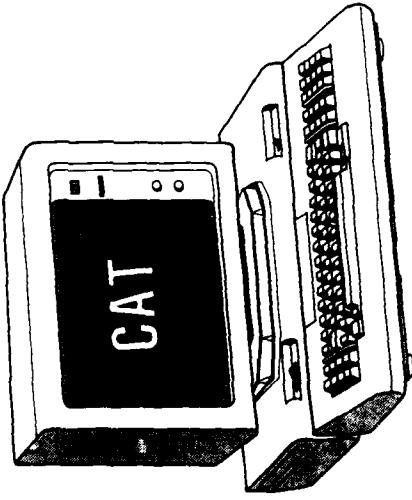
The changes to be implemented will utilize recommendations from the American Corrections Association on operating procedures, training programs, and systematic classification of detainees and prisoners. In order to assure that this revised correctional system is meeting its goals and to assess the effectiveness of the specialized programs being implemented, an evaluation plan with a system for data collection is necessary.

This effort will design and recommend a system to evaluate both the processes and outcomes of the Navy Consolidated Brig System. The resulting evaluation plan will specify the methodology for assessing process strengths and personnel



Applications of Testing Systems

Computerized Testing



Testing Systems Function and Product Line Descriptions

Develops and evaluates personnel testing systems and computerized adaptive testing (CAT) versions of the Armed Services Vocational Aptitude Battery (ASVAB). Serves as lead Department of Defense laboratory for overall management of CAT research, development, implementation, and scientific support of the system.

Computerized Testing Systems--Develops, procures, tests, and evaluates the microcomputer-based delivery system for the CAT-ASVAB program and is responsible for the design, development, and implementation of the CAT-ASVAB Maintenance and Psychometric (CAMP) Facility.

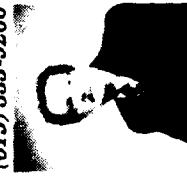
Printed Testing Systems-- Provides research support for the development of the CAT version of the ASVAB as well as for the current operational paper-and-pencil version of the test battery (P&P-ASVAB).

Printed Testing



Computerized Adaptive Testing for ASVAB (CAT-ASVAB)

Officer-in-Charge
CAT-ASVAB Program:
W. A. Sands
(619) 553-9266



The Armed Services Vocational Aptitude Battery (ASVAB) is used by all U. S. military services to determine enlistment eligibility and to classify selected applicants into entry-level training. The current version of this aptitude battery consists of 10 tests and is administered in a paper-and-pencil mode (P&P-ASVAB). Due to this conventional administration mode, P&P-ASVAB has a number of important shortcomings including (1) inability to employ dynamic test questions (e.g., target acquisition and tracking), (2) lengthy test administration time, (3) a lack of measurement precision at both the high- and low-ends of the ability continuum, (4) susceptibility to theft and test compromise, (5) high costs for printing, distribution, and storage of test materials, and (6) long lead time and high cost of developing replacement forms.

The purpose of this R&D program is to develop, test, and evaluate a Computerized Adaptive Testing version of the battery (CAT-ASVAB) as a potential replacement for P&P-ASVAB. Work is proceeding simultaneously in two areas, psychometric research and delivery system development.

Both of these R&D areas support the Accelerated CAT-ASVAB Project (ACAP). ACAP was instituted to get CAT-ASVAB into the field with off-the-shelf hardware rather than incurring a major delay that would result if computer hardware were developed specifically for the project.

In FY88, psychometric investigations focused on the relationship between P&P-ASVAB and CAT-ASVAB. One effort measured the effects of the medium of administration (i.e. paper-and-pencil vs. computer) and effects on computerized adaptive scores from the use of paper-and-pencil item parameters. Another study used cross-correlation procedures to compare CAT-ASVAB and corresponding P&P-ASVAB test reliabilities using the ACAP item pools and computerized delivery system.

Delivery system development during FY88 focused on the software required to support the ACAP system. This included final development and testing of the software for the Test Administrator and Examinee Testing Stations, as well as for the Data Handling Computer. Local Area Network software was also developed to handle communications between the stations and the Data Handling Computer.

During FY88, the first major field test of the system was initiated--ACAP Score Equating Development. CAT-ASVAB and P&P-ASVAB data will be collected from approximately 7,500 military applicants in six locations nationwide. These data will permit the two versions of the battery to be equated (i.e., placed on the same measurement scale). Score equating development will permit CAT-ASVAB scores to be treated in the same manner as P&P-ASVAB scores for accessioning applicants into the military. Data collection will be completed early in FY89 with final analyses and documentation completed in

late FY89. Score equating development will also provide an opportunity for a full scale check of the ACAP hardware and software systems.

In FY90, a verification of the results of score equating development will continue into FY92 and equating verification will allow a decision to be made on whether to proceed with full-scale development of the CAT-ASVAB system. Development of the CAT-ASVAB Maintenance and Psychometric (CAMP) Facility has progressed to the point where the facility is now able to process the massive amounts of data collected during score equating development and verification.

Plans are currently underway for a program to develop new, dynamic, computer-administered tests for the CAT-ASVAB battery. These "future tests" could include measures of reaction time, spatial ability, cognitive speed, as well as psychomotor skill. Future tests will be able to measure aptitudes that cannot be tapped by traditional paper-and-pencil testing and will offer the greatest potential for a significant breakthrough in personnel testing in decades.

P.E. 0803732M
P.E. 0804703N
Reimbursable

Report:

Falchi, J. S. (October 1986). *Communication of computerized adaptive testing results in support of ACAP*. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.

Hetter, R. D., & Segall, D. O. (November 1986). *Relative precision of paper-and-pencil and computerized adaptive tests*. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.

James-Jones, G. (November 1986). Design and development of the ACAP test administration software. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.

Lee, J. A., Moreno, K. E., & Sympon, J. B. (1986). The effects of mode of test administration on test performance. Educational and Psychological Measurement, 46, 467-474.

Rafae, B. A. (November 1986). Development of the test administrator's station in support of ACAP. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.

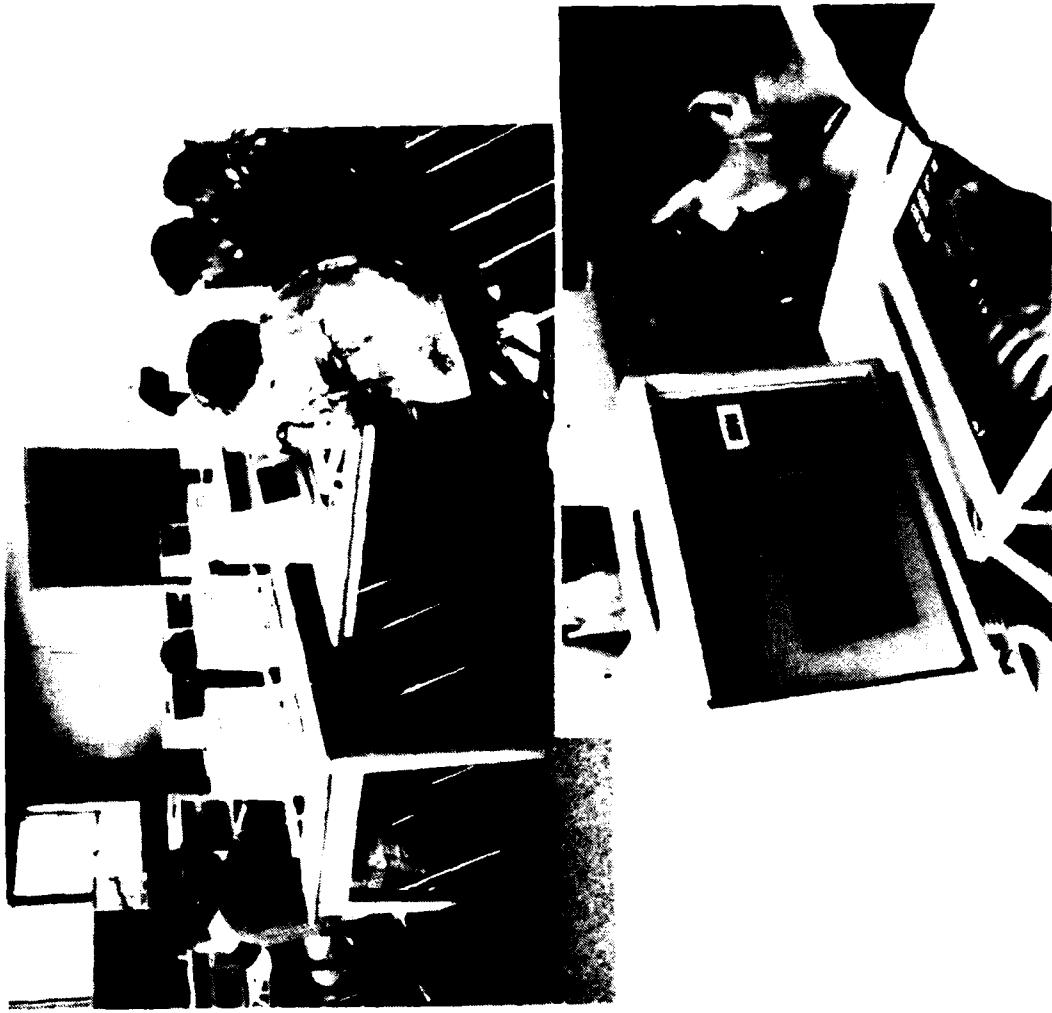
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Sands, W. A. (November 1986). Computerized adaptive testing hardware/software development for the U. S. Military: Introduction and overview. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.

Vicino, F. L., & Hardwicke, S. B. (April 1984). An evaluation of the utility of computerized adaptive testing. Paper presented at the Annual conference of the American Educational Research Association, New Orleans, LA.

Vicino, F. L., & Moreno, K. E. (April 1988). Test takers attitudes toward and acceptance of a computerized adaptive test. Paper presented at the Annual Conference of the American Educational Research Association, New Orleans, LA.

Wilbur, E. R. (November 1986). Design and development of the ACAP test item data base. Paper presented at the 28th Annual Conference of the Military Testing Association, Mystic, CT.



Armed Services Vocational Aptitude Battery (ASVAB)



Principal Investigator:
Paul Foley
(619) 553-9263

The objectives of the Navy's effort are to (1) validate the ASVAB as a tool for improving standards for school assignment, (2) assist in a joint effort with other services to develop new test forms and to make other necessary improvements to the ASVAB testing program, and (3) validate the ASVAB against measures of job performance in addition to academic performance in Class "A" schools.

The approach is to demonstrate the validity of ASVAB entrance standards at the '75 Navy Class "A" schools, particularly for those that have had either a change in curriculum and/or an increase in attrition. Students' school grades are collected from Navy schools and are related to ASVAB test scores. Recommendations are made concerning a change to the minimum qualifying score on the ASVAB school composite or a change in the composite itself. Either change could reduce attrition and/or provide larger numbers of qualified personnel than provided by current standards. Job performance data are also being gathered in selected Navy ratings to supplement students' grades provided by the school.

ASVAB is a Joint-Service multiple aptitude battery used for selection of applicants and assignment of those selected into military occupations. The Armed Forces Qualification Test (AFQT), formed of four of the battery's 10 tests, is used for selection while 11 different Class "A" school composites, formed of the 10 tests are used for assignment. The ASVAB is administered at Military Entrance Processing Stations (MEPS) and at Mobile Examining Team Sites (METTS). Following introduction of the ASVAB testing program, the Joint-Service Selection and Classification Working Group (JSSCWG) was established to: (1) involve the services in ASVAB-related selection and classification decisions, (2) coordinate the research efforts of the individual services, (3) concentrate the personnel resources of all service laboratories in resolving common testing problems, and (4) provide for the development of replacement test forms, as well as the overall maintenance of the ASVAB program. NPRDC provides a representative to the Technical Working Group of the JSSCWG, and serves as a consultant to Navy personnel policy makers on ASVAB testing matters.

Validation of ASVAB school composites has been completed at several Class "A" schools. The first conducted at the Disbursing Clerk (DK) school resulted in replacement of the existing composite. A validation study of the Radioman (RM) school resulted in the recommendation of a replacement composite. A validation study for the Interior Communications (IC) school recommended retention of the current ASVAB composite, but an increase in the minimum qualifying score to reduce attrition. A validation study was also conducted for the Aerographer's Mate (AG) school, where an alternative composite was recommended to replace the current composite.

Two validation studies of occupational groups have been conducted. The first was the Navy electronics occupational group that contains 11 ratings, all of which use the electronics composite. The study confirmed this to be the most valid composite. It was also recommended that the current minimum qualifying score was appropriate and that, if raised, a large proportion of graduates would be eliminated without a significant reduction in attrition. Operations control, which contains seven class "A" schools, was the second occupational group. Preliminary results indicate that two composites may be sufficient. This would simplify the Navy's classification system, one of the objectives of this study. Progress has also been made on developing a conversion table for estimating the reading grade level of incoming recruits using one of the composites of the ASVAB.

In FY89, NPRDC will be investigating the possibility of simplifying the scoring of ASVAB Forms 15-17 by reducing the required number of raw score-to-standard score conversion tables. The Gas Turbine Technician (GS) school will be validated along with three other schools of the mechanical occupational group. Work will also continue on simplifying the Navy's classification system.

Reimbursable

Reports:

Foley, P. P., Held, J. D., & Monzon, R. I. (in preparation).
Validation of the ASVAB selection criteria for the IC class "A" school and the prerequisite BE/E school. San Diego: Navy Personnel Research and Development Center.

Foley, P. P., Held, J. D., & Monzon, R. I. (in preparation).
Validation of the ASVAB selection criteria for the DK class "A" school. San Diego: Navy Personnel Research and Development Center.

Held, J. D. (in review). *Validation of the ASVAB selection*

criteria for the RN class "A" school. San Diego: Navy Personnel Research and Development Center.

Monzon, R. I. (in review). *Validation of the ASVAB selection criteria for the AG class "A" school. San Diego: Navy Personnel Research and Development Center.*

Monzon, R. I., & Foley, P. (in review). *Assessment of alternative AFQT composite definitions. San Diego: Navy Personnel Research and Development Center.*

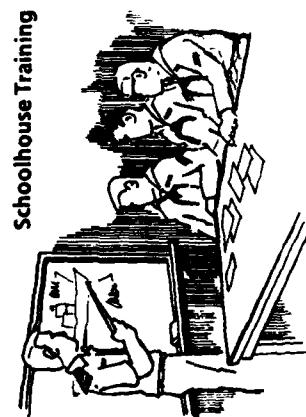
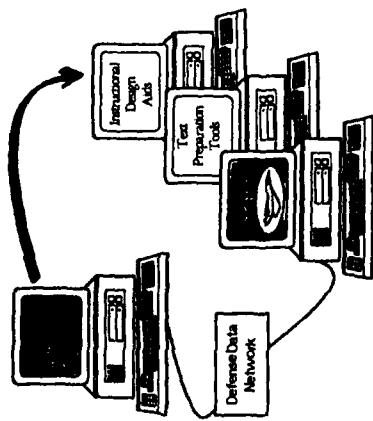
Monzon, R. I., & Held, J. D. (in review). *Validation of the ASVAB selection criteria for the basic electricity (BE&E) schools and their follow-on class "A" schools in the electronics occupational group. San Diego: Navy Personnel Research and Development Center.*



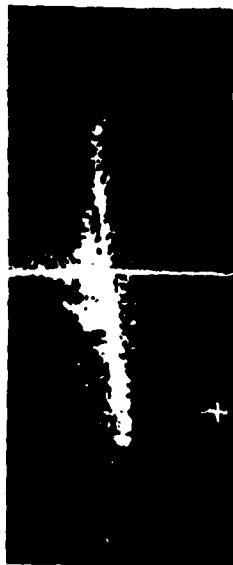
ASVAB tests are used as an aid for placing recruits into Navy jobs

Applications of Education and Training

Curriculum Acquisition, Development & Revision



Operational Training



Education and Training Function and Product Line Descriptions

Develops training technologies to enhance personnel readiness. Employs existing and emerging technologies in the development and application of training systems to alleviate Navy training problems and to improve the Navy's operational readiness.

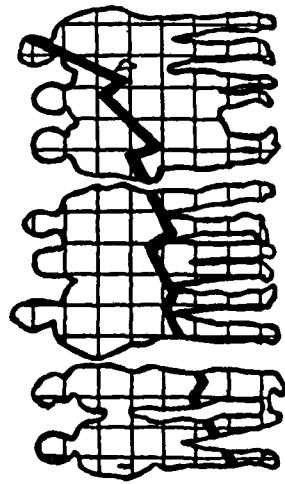
Curriculum Acquisition, Development, and Revision--
Develops, tests, and evaluates systems designed to support the development of curriculum materials. These include automated systems designed to support instructor delivered training materials; and systems for computer delivered training materials.

Schoolhouse Training--Develops content specific instructional materials and processes designed to enhance the effectiveness and lessen the cost of the delivery of formal Navy Schoolhouse instruction.

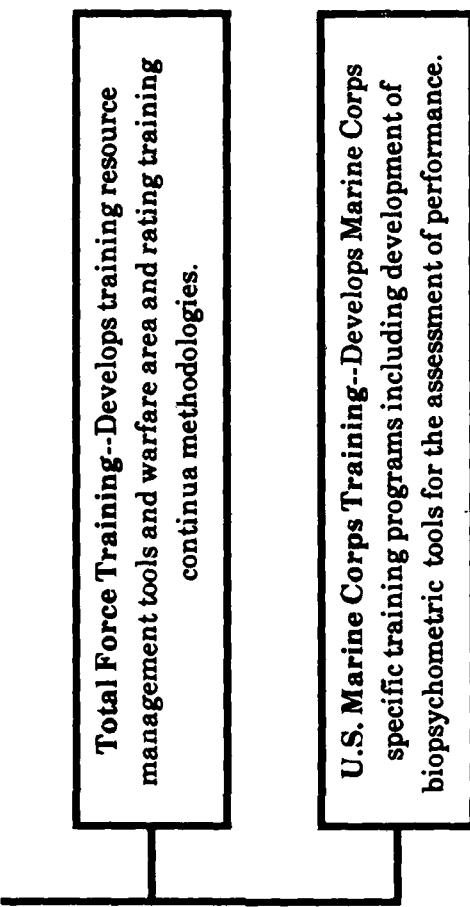
Operational Training--Develops training programs to support specific operational weapons systems including enhancements to existing programs, and application of emerging training technologies to these systems.

Applications of Education and Training

Total Force Training



Education and Training (Continued)



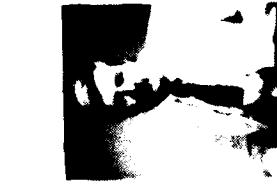
USMC Training



Authoring Instructional Materials (AIM)

Principal Investigators:

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Wallace Wulfbeck
(619) 553-7788/9269



and production of instructional materials for both conventional and computer-delivered courses. The systems are intended to support military instructional development by providing computer-based tools that reduce the time, effort, and expertise needed to produce high-quality instructional materials. Initial attention in this effort will be given to building computer-based tools for developing printed materials (both text and graphics) for conventional, classroom-based instruction.

During FY85, the AIM curriculum authoring system requirements and the hardware specifications were defined. The computer systems were then purchased and installed at the Instructional Program Development Division of the Naval Education and Training Support Center, Pacific and at Engineering Systems Schools Department, Service School Command, Naval Training Center, Great Lakes.

The Navy has a continuing need to make the production and revision of instructional materials more efficient and effective. The basis of this need is that the Navy teaches over 7,000 different courses, which require maintenance and revision. In addition, new equipment and more efficient delivery techniques, like computer-based instruction (CBI), increase development and revision requirements. Currently, the production of 1 hour of instruction requires from 100 to 1,000 man-hours of effort by highly experienced personnel, at a cost of from \$5,000 to \$50,000. As personnel costs increase and as technological advances necessitate new, increased, and more sophisticated training, the Navy's ability to meet its instructional material needs will be seriously affected by continuing budget restrictions. Finally, regardless of funding restrictions, there is a shortage of personnel who are experienced enough to develop or revise courses for the fleet.

The objective of this project is to develop automated systems for the design, development,

In the remaining out-years, the Submarine School and RTF test sites will be made operational and the in-house software will be enhanced and integrated by means of the software support contract. This integrated AIM curriculum development system will then be tested, evaluated, and refined for transition to Navy-wide implementation. The project will also design econometric tools to model and evaluate various instructional development processes with different levels of automated tools. Finally, the software will be moved to smaller computer systems so that these computer-based tools can be distributed to individual schools.

P.E. 0603720N

Reports:

Chang, F.R. (1986). Development of a computer-based writing assistant: Report (NPRDC TR 86-10). San Diego: Navy Personnel Research and Development Center.

Vogt, J., Robinson, E., Taylor, B., & Wulfbeck, W. (in press). AIM (Authoring Instructional Materials): Automating the Navy's curriculum development process. San Diego: Navy Personnel Research and Development Center.

Vogt, J. L., & Wulfbeck, W. H. (in press). Approaches to the automation of curriculum development. San Diego: Navy Personnel Research and Development Center.

Vogt, J. L., & Wulfbeck, W. H. (1987). Automation of instructional development in the U.S. Navy. Paper presented at American Society of Engineering Education Conference, Lake Buena Vista, FL.

In FY87, the AIM demonstration test sites were expanded to include Fleet Training Center, Pacific; Gunners Mate School, NTC, Great Lakes; and Chief of Naval Technical Training, Memphis. The prototype AIM software system, supporting MilStd 1379C and the Navy Handbook for Training Materials Development (MIL-HNDK-292), was expanded to include many of the primary steps used for curriculum design and development. Test sites were established at Naval Submarine School, New London; Trident Training Facility (RTF), Kings Bay, GA; and RTF, Bangor, WA.

Low-cost Microcomputer Training Systems

Principal Investigators:

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analysis of course objectives and a survey of course managers. About 30,000 training objectives from a broad sample of Navy training programs were collected to determine the relative frequency with which various types of training practices occur.

The most frequently occurring objectives were remembering of facts and practice of procedural steps. Interviews with Navy course managers or instructors in courses with an annual throughput of more than 400 students identified current instructional practices and potential areas for the development of computer-managed instructional support and CBI. The results of both of these assessments were made available during 1987.



Navy systems are becoming more sophisticated, requiring more time and effort to train personnel, while funds for training are remaining constant or declining. At the same time, rapid advances are being made in computer technology and in developing instructional applications for microcomputers. This project is essential to the development of a coherent investment strategy for microcomputer applications in Navy education and training. By assessing Navy training and education practices and matching them with various forms of microcomputer-based training innovations, maximum advantage can be taken of computer technology in cases where it is cost effective.

The objectives of this project are to (1) assess Navy training practices and (2) develop, test, and evaluate computer-based instructional (CBI) systems for a variety of Navy training applications. The approach for assessing Navy training requirements has involved both an

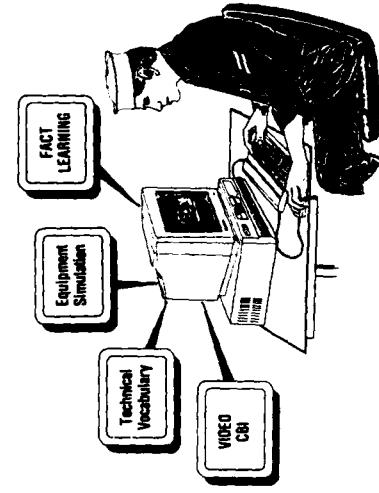
(1) an author mode for subject-matter experts to use to enter new instruction, (2) an instructional delivery mode in which the program interacts with students, and (3) an instructional management mode to record, score, and track student progress.

Currently, the CBESS programs are being tested in selected Navy training courses. Future work will be concerned with software and library enhancement and development of cost/benefit measures and logistics prescriptions for CBI systems.

P.E. 0603720N

Report:

Wetzel, C. D., Van Keterix, D. L., & Wulfek, W. W. (1987). *Analysis of Navy technical school training objectives for microcomputer-based training systems (NPRDC TR 88-3)*. San Diego: Navy Personnel Research and Development Center.



The main thrust of the development, test, and evaluation of CBI systems has been the testing of software developed on contract. This effort is standardizing CBI programs that have previously been shown to be of practical utility in Navy training under a system called the computer-based educational software system (CBESS). This system consists of a set of C-language programs that are relatively portable for a variety of computers and Navy environments. Portability is a significant issue, since the proliferation of many machine-specific programs has in the past caused duplication of effort. CBESS consists of four major elements: (1) the equipment problem solving trainer (EPST) program is a computer- and video-based simulation system designed to reduce reliance on the use of actual equipment and to troubleshoot malfunctions; (2) the computer-based memorization system (CBMS) that uses a semantic network to represent large bodies of facts to be memorized through data base browsing and gaming; (3) the language skills computer-assisted instruction (LSCI) program that provides training in general and technical vocabulary and reading; and (4) a General CBI package that allows presentation of screens, asking of questions, and branching based upon student response. All of the CBESS programs have three common components:

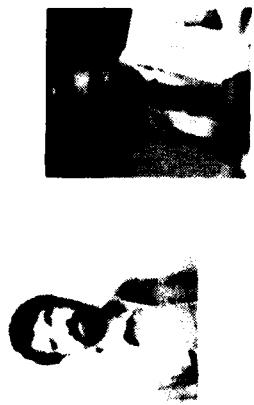
Artificial Intelligence (AI) Tools for the Development of Instruction

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Wallace Wulfeck

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develop more intelligent aids for instruction and to reduce development costs and expertise required for use of computer technologies in training. The goal is to evaluate the use of current and emerging AI hardware and software technologies for the generation of training materials. In particular, tools for text processing, editorial assistance, task decompositions, and graphic representations, will be developed and evaluated. These tools should increase the productivity of Navy curriculum developers and enhance the performance of students.

The Navy is attempting to decrease the substantial costs and time associated with the production of training materials (including graphics and other supporting documents). These extensive time and funding demands of instructional materials are caused by several factors, including the large number of courses, the expensive and complex nature of a systems approach to the development of curriculum materials, the increasingly sophisticated equipment that Navy technicians are asked to operate and repair, and the shortage of experienced personnel for generating training materials. To meet this challenge, the Navy must develop and use tools which make this process more efficient.

This project will apply techniques from AI toward building improved aids for designers of instructional materials. The main objective is to

evaluated, revised, and transitioned to Navy training environments.

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During this effort a set of AI-based tools for the development of training materials will be produced. The first tool under development is a comprehensibility aid that assists Navy instructional writers in generating more understandable technical prose. Another tool in the early design stages is an object-oriented software program to assist curriculum designers in the analysis phase of instructional systems development. Additional tools using AI techniques, such as assisting Navy instructional writers in the more efficient use of graphics materials are also in the planning stages.

During FY 87, planning and coordination work was done with the several test sites. Work was started on one group of tools, text comprehensibility aids, by providing funds under an existing Office of Naval Research (ONR) contract to the University of Michigan. In FY88, work continued on the text comprehensibility aids and on the design tools. These design tools consist of developing a set of visual, object-oriented programs that aid in the process of job task analysis and course/lesson design. Special attention was given to human-computer interface issues so that these tools can be easily used. In the future AI-based tools for assisting with instructional graphics will be developed, and all of these tools will be tested,

This project will apply techniques from AI toward building improved aids for designers of instructional materials. The main objective is to

Future Technologies for Training

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The reduced availability of senior technical personnel and the increasing sophistication of naval equipment present major training and operational problems for the Navy. The Navy must meet the challenge of training personnel to understand, operate, and maintain increasingly complex and ever-changing equipment. One promising approach to these problems is the application of novel principles of human-machine interaction that have been developed under the rubric of "cognitive science." The problem addressed by this project is how these approaches can be used to the best advantage in computer-based systems. There is great potential benefit from new and sophisticated human-machine interface approaches. First, they can minimize the amounts of time and effort users must spend on the "overhead" of learning to use the software. Second, they can maximize the extent to which the software itself promotes the learner's or user's development of an appropriate functional model of the real-world content domain. This project entails the empirical evaluation of various new approaches to the design of human interfaces for complex software.

The development of an appropriate set of interface-design principles has the potential for very far-reaching beneficial effects—not only in the arena of Navy training, but more broadly as well. Trainees using computer-based training systems may be able to learn more rapidly and more easily (with reduced error and frustration). In the arena of development of computer-based training, more appropriately designed interfaces for course development can relieve course developers of much of the burden of gaining software expertise before they can construct the initial version of a course and can encourage appropriate revision and updating of course materials by making them much less difficult and time-consuming. With military training continuing to increase its reliance on computer-based training, as encouraged by the Deputy Under Secretary of Defense for Research and Engineering, the value of better computational tools increases as well.

The current research focuses on empirical studies of the impact of interface features on user performance with the goal of constructing and validating a set of guidelines for appropriate user-interface design that will facilitate learning and performance. After making refinements suggested by pilot data, data-gathering for the first major study was begun. Some qualitative and quantitative consequences of interface style on users' learning and performance were examined. This work evolved in the context of the collaborative NPPRDC/University of California, San Diego laboratory (located at the University), which was partially supported by the Office of Naval Research "Bridges" program.

Also, a final version is now completed of the simulation environment (SIMENV) facility, whose development was a previous focus of this project. SIMENV is a general integrated environment for

the construction, observation, and manipulation of graphical displays of complex real-time processes and simulation models. It allows users extensive control without requiring explicit programming. It is currently being used in experimental work at NPPRDC and Naval Aeronautics and Space Administration.

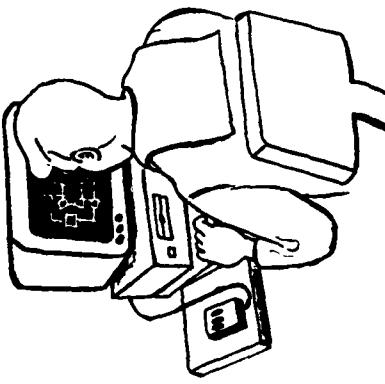
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Reports:

Hollan, J. D., Hutchins, E. L., McCandless, T. P., Rosenstein, M., & Weitman, L. (in press). *Graphical interfaces for simulation*. In W. B. Rouse (Ed.), *Advances in man-machine systems research*, 3. Greenwich, CT: JAI Press. Also published as ICS Report No. 8603. La Jolla, CA: University of California, San Diego, Institute for Cognitive Science.

Hutchins, E. L., Hollan, J. D., & Norman, D. A. (1985). *Direct manipulation interfaces: Human-computer interaction*, I. 371-338. Hillsdale, NJ: Erlbaum. Also published as ICS Report No. 8503. La Jolla, CA: University of California, San Diego, Institute for Cognitive Science.

Schustack, M. W. (1987). *Interface style and users' learning and performance: What's hard and what's easy and why*. Paper presented at the Computer-Human Interaction 1987 conference. Schustack, M. W. (1987). *How interface style influences user performance*. Lecture seminar presented to NASA Ames Research Laboratory, Aerospace Human Factors Research Division.



Computer-based Instruction (CBI) Authoring Tools System

Principal Investigator:

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student responses in a variety of forms, including inputs from a touch panel. On the other hand, it can be used to produce lessons for delivery on relatively small computers that have no more than a keyboard, a monochrome monitor, and a single floppy disk drive. It is extremely flexible in handling complex contingencies for branching.

CBI Authoring Tools System (CATS) is one of two CBI authoring/delivery systems developed by NRPDC and available at no cost to government users. The other is Computer-based Educational Software System (CBESS), which is described in the profile for the Low-cost Microcomputer Training Systems Project.

CATS was initially developed to meet the needs of a particular project when no other authoring system could be found to meet those needs. Many capabilities have been added to the system since then to meet the needs of new projects. Modifications are still being made but at a reduced rate. All funds for system development were drawn from projects that were oriented primarily toward the production of training materials. Independent funding for the system, which has been available for the last two years, has been devoted to the preparation of a user's manual.

CATS provides most of the capabilities available in other CBI authoring systems. It can overlay graphics on both still and moving video images, display animated graphics, and accept

will be available early in FY89. With the manual, CATS becomes a package that can be readily exported to any interested government user.

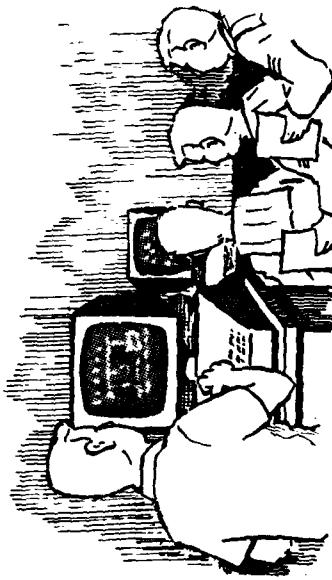
There will be a small continuing effort in FY89. The user's manual will be revised to cover some of the newer system capabilities. The source code documentation will be revised to make it more self-sufficient. Consideration will be given to developing a spartan version of the system that can be used to write simple lessons on small floppy disk computers.

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It is highly structured and written in C language, which promotes both transportability and ease of modification. It can run on Zenith 100 or IBM PC/XT/AT compatible computers. Material can be written on these same computers or on a VAX. Lessons that do not call for graphics can be transported from one of these computers to another without modification. Transporting graphics is more of a problem. The system uses bit-mapped graphics. In some cases, the graphics will transfer without modification, in others, they can be converted through the use of graphics editors, but in some, they will have to be redrawn. It is relatively simple to write drivers for such items as new video disc players, new pointing devices, or new graphics boards.

The system is unusual in that it does not provide its own text or graphics editor. All materials are written with commercial editors chosen by the author and are stored in regular files and directories. Most commands are written in plain English, and there is little or no need for programming skills. The major disadvantage of this approach is that the system provides no prompts or menus to the author. However, there is no need to learn new editors. There are relatively few built-in constraints on lesson design and lesson elements that are used repeatedly, ranging from simple comments to extended series of interrelated frames, and they can be copied from previously developed files.

A usable draft of the user's manual was completed in June 1988. A more polished version



Distributing Instructional Expertise

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Henry Simpson

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little impact beyond the research laboratory. Advice-giving expert systems, while less expensive to develop, work within restricted domains and are not generally suited as primary vehicles for instructional delivery. The use of artificial intelligence to build machines that can converse in natural language has obvious implications for instructional delivery. Unfortunately, the availability of machines that can effectively communicate in full, natural language appears to be many years away. Thus, while artificial intelligence appears to have considerable potential, its practical use in systems that might be designed today for instructional delivery remains unclear.

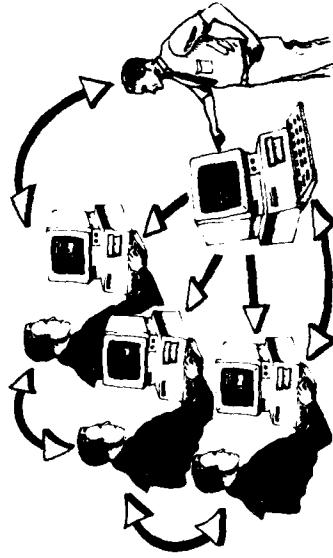
The Navy training community has yet to capitalize fully on newer computer technologies such as computer networking and artificial intelligence. In principle, both technologies have much to offer. Computer networking can be used to link together student and instructor, without regard to geography, and without even the requirement for real-time interaction. Programs with artificial intelligence can be used to deliver training, reducing the need for live instructors and the load on existing instructors. When the two technologies are combined, the potential exists to make instructor expertise available when and where needed.

Yet, many obstacles must be overcome before these technologies can be combined effectively in a training setting. Computer networks have traditionally been used by individuals with a high level of computer sophistication. Appropriate user interfaces and forms of dialogue must be developed to allow the unsophisticated or occasional user to learn and use a network proficiently. The use of artificial intelligence is even more problematical. The types of intelligent tutoring systems that might conceivably replace a live instructor are enormously expensive to develop and have had

designed. System development was commenced. A research plan was written to use as the basis for investigating various system attributes and refining the system in its subsequent evolution. The system initially developed will incorporate little or no artificial intelligence. Artificial intelligence will be added to future versions of the system as it evolves. It is planned to complete development of the application during FY89 and to field test it in an ongoing training course.

Expected payoffs of this research are: (1) prototype instructional support system that may be used as a model for other systems of its kind, (2) a set of guidelines for the use of such systems, (3) more efficient use of instructor resources, and (4) improved technical training.

P.E. 0602233N



The objective of this project is to develop an instructional support system consisting of an instructor, computer-based communication network, subject, matter data base (routine queries) or a live instructor (non-routine queries). Major issues to resolve are the distribution of knowledge between instructor and computer; the forms of computer-based instruction, dialog, and types of user interface to employ; subject-matter coverage; and specific attributes of the prototype design.

Project work has focused in two main areas. The first is a review of research in computer networking, with a particular emphasis on the use of networks for instructional delivery. The second area is a review of artificial intelligence applications in the training domain. A by-product of this work is a taxonomy of training functions and related computer applications.

In FY88, the project selected a topic currently being taught in a Navy course, analyzed the instructor-student discourse relating to that topic, and isolated recurrent queries for incorporation in a computer data base. System hardware was selected. Forms of user interface and dialog were

Enhancing Training Motivation

Principal Investigator:

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in 200 male Navy recruits in their final 2 weeks of training at the Recruit Training Center, San Diego. Task attribution, outcome attribution, and failure tolerance were measured. High levels of motivation were found in these recruits. Based on this study, it was decided to measure motivation in beginning recruits to determine change as a result of training. The findings from this study of 350 recruits are in the process of being analyzed. (2) Motivation characteristics were measured in a study of 250 Basic Electricity/Electronics (BE/E) students in Memphis, assigned either to a group- or self-paced learning presentation. Findings from this study revealed similar levels of motivation in both groups of students, with the self-paced group showing slightly higher levels of satisfaction with

The military assumes that some of the deficiencies observed in training effectiveness and job performance skills are due to low motivation. The purpose of this project is to (1) define motivation for training, (2) determine appropriate variables of motivation related to training, (3) measure motivation levels in Navy training environments, (4) develop a program of training motivation based on the findings of these experiments, (5) implement this program on a trial basis, and (6) provide the Navy with a set of guidelines for the use of motivation in training.

In this project, training motivation has been defined in terms of learning persistence. Whereas, learning is typically viewed as the acquisition and retention of knowledge, the research team has added the important variables of learning persistence, level of task choice, self-direction, and task-specific motivation. The project is guided by intrinsic motivation theory and attribution theory.

In FY86, training motivation was measured in several training environments. (1) A study was conducted to measure motivation characteristics

the instructors' expertise, more confidence in test performance, and more feeling of self-direction in study than did the group-paced students. (3) A quick-response study was performed for the Navy to evaluate the positive motivation program at the Recruit Training Centers. Recruits are put into this program if they are making a poor adjustment to the Navy and if they have motivation problems. The study was conducted to investigate the effectiveness of this program. It was found that the attrition levels in the positive motivation group were accounted for by those recruits who had not graduated from high school and/or were under 18 years of age. Otherwise, recruits in this program stayed in the Navy at a rate similar to regular recruits.



In FY87, a large empirical study was conducted at the BE/E School, San Diego, to assess the independent and interactive effects of abilities, motivational disposition, and instructional methods on rate of learning in complex skill acquisition. In addition, a motivationally enhanced computer-based instruction program was being developed to teach BE/E concepts. In the empirical study, over 400 students were randomly assigned to one of three goal assignment conditions: (1) do your best, (2) attain a specific, difficult cumulative learning rate goal at the end of the first seven modules of the curriculum, or (3) attain a specific difficult learning rate goal for each of the first 13 modules in the course. Students were also assigned to one of two feedback conditions: (1) evaluative charting of the learning rate scores or (2) no charting of scores. A control condition in which subjects collected information but were not given goals or feedback on learning rate was also implemented. These data are in the process of being analyzed.

In 1988, a motivationally enhanced computer-based instruction (CBI) program was developed. This program is intended to keep students persisting at difficult BE/E learning tasks for many trials without quitting. The CBI uses gaming features, goals and feedback, and failure tolerance manipulations to promote student persistence. These programs will be tested at the BE/E School for effectiveness. In addition, guidelines are being prepared for instructors and instructional developers at Chief of Naval Education and Training (CNET) schools and at the instructional training (IT) schools. These guidelines will be presented in an in-service training videotape.

Reports:

Clifford, M. M., Kim, A., & McDonald, B. S. (in press). *Responses to failure as influenced by task attribution, outcome attribution, and failure tolerance*. *Journal of Experimental Education*.

McDonald, B. A. (in press). *Motivation and training: Prescriptions for change*. In Dillon, R. & Pellegrino, J. (Eds.), *Instruction: Theoretical and applied perspectives*. New York: Praeger Publishers.

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McDonald, B. A. (1987). *What works: Capturing and holding students' attention*. Talk presented for San Diego Instructional Series, San Diego, CA.

McDonald, B. A., Hurlock, R. E., Whitehill, B. V., Wulfeck, W. H., & Ellis, J. E. (in press). *Motivation characteristics of self-paced and group-paced learning environments*. San Diego: Navy Personnel Research and Development Center.

McDonald, B. A., Hurlock, R. E., Whitehill, B. V., Wulfeck, W. H., & Ellis, J. E. (1987). *Self-paced and group-paced instruction in basic electronics and electricity training: A comparative evaluation*. Paper presented at Military Testing Association, Ottawa, Canada.



Schoolhouse Productivity

Principal Investigator:

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(619) 553-9273



The Navy currently teaches over 7,000 courses. The great majority of these courses are presented in traditional classrooms and laboratories with a group of students taught by a single instructor. Directives by Chief of Naval Operations and Chief of Naval Education and Training indicate that this training format will continue to play a predominant role in Navy education and training. Although much R&D effort has been expended on alternative instructional delivery methods (e.g., individualized, computer-managed, self-paced instruction), little has been done to improve conventional classroom instruction and instructors. There have been few systematic attempts to integrate emerging instructional methods and technologies into Navy classrooms.

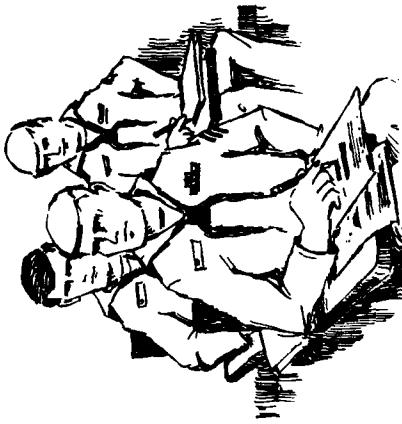
A recent review of Navy classrooms by the Navy Personnel Research and Development Center found: (1) inconsistencies between classroom objectives and test items, (2) objectives and test items that were not appropriate for job requirements, (3) a lack of opportunities to practice knowledge objectives, (4) a failure to incorporate into Navy school the methods and practices that have been shown to be effective

in civilian classrooms (e.g. peer tutoring, advance organizers, motivation techniques), (5) a lack of in-service training for instructors beyond instructor training school, and (6) a lack of technology used to supplement classroom training. In the face of increasing pressures on the training system to increase its efficiency and effectiveness, the improvement of Navy classroom training is an important issue. The problem is to determine whether and how the deficiencies identified in the NPRDC project can be corrected in Navy classroom training and whether available and emerging methods and technologies can be exploited to enhance learning and retention. For example, can findings from various civilian research efforts be effectively applied in the Navy? The Navy classroom differs from the civilian classroom in a number of significant ways. Thus, one question is how can civilian findings be applied and what effect will they have on Navy personnel. It is very probable that many of these results are generic enough to transfer to a "different" type of classroom situation and can be combined to significantly improve learning and retention. Due to a greater level of control in Navy classrooms, one of the interesting research issues is if they can be implemented in ways that will increase the magnitude of the effects observed in the civilian community.

Based on the findings of the NPRDC study, it is important to note that not all 7,000 Navy courses are in need of significant improvement. In fact, the majority of these courses would realize little benefit from attempts at improvement because of very small class sizes. Most Navy courses have class sizes of less than 10 and many of them have five or fewer students. With classes this small, the individual instructors can usually overcome problems inherent in the instructional materials and process. Furthermore, courses with small classes are frequently equipment-oriented where most of the instructional time is spent working in laboratories rather than sitting in classrooms. Therefore, the focus of this project will be on courses that have large classes (15 or more), a large annual throughput, and have a significant amount of instructional time invested in classroom training (i.e. the project will concentrate on "A" school training).

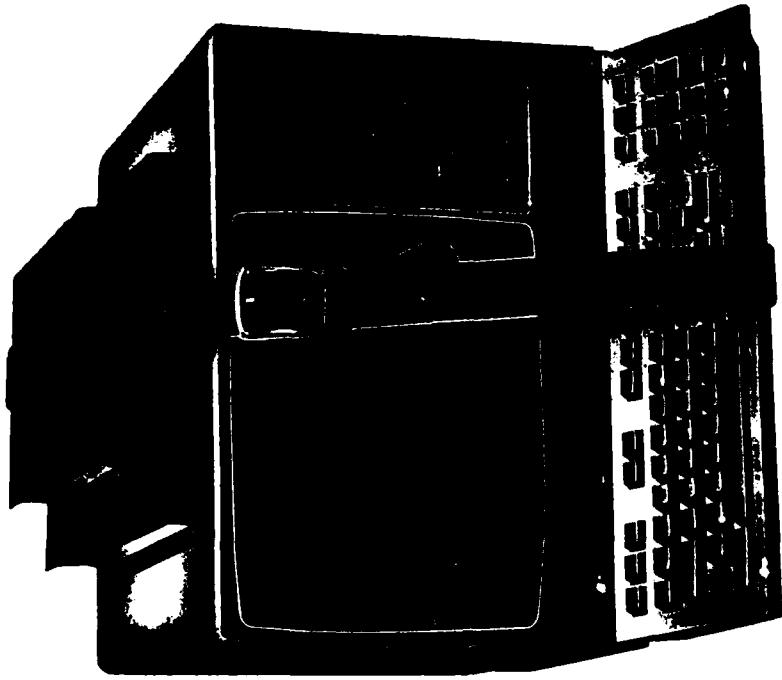
Navy schools, like their civilian counterparts, have not taken advantage of the considerable amount of research and development done by educational and instructional researchers on how to improve traditional classroom instruction. The Navy has a significant investment in laboratory equipment and training but has done little to modernize the standard classroom environment from both a technology and an instructional methods viewpoint. The objective of this project is to demonstrate that state-of-the-art instructional methods and technologies can be applied in the classroom environment to increase knowledge and skill acquisition and retention at a price that is not cost prohibitive. In addition, the project will continue to research and develop additional methods and technologies that have potential application in Navy classrooms.

The project was a new start in FY88 with NPRDC selecting school sites in cooperation with



Commander, Training Command, Pacific, Chief of Naval Education and Training, and Commander, Training Command, Atlantic. It is anticipated that there will be sites in San Diego, Great Lakes, and possibly Norfolk. The Great Lakes site has already been identified as the Electrician's Mates "A" school. Once sites are established, we will begin to implement the recommendations of the previous 6.2 effort Classroom Instructional Technologies. Specifically, we will be developing and testing instructional methods and technologies in at least five areas: job-oriented training, automated remediation, in-service training, cooperative learning (peer instruction), and criterion referenced testing. Also, the data collection model and evaluation plan will be developed and data collection and evaluation will begin. In the future, we will continue to implement, test, and revise instructional methods and technology applications at the initial sites and add additional sites as feasible.

P.E. 0603720N



Advanced Computer-aided Instruction: STEAMER

Principal Investigators:

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STEAMER currently consists of a graphical interface using the same mathematical model that drives the 19E22 trainer at the Surface Warfare Officer School (SWOS) at Newport, RI. The model can be observed and manipulated at different hierarchical levels. The system is designed so that it can be used in a variety of ways. It can, for example, be used by an instructor to provide students with demonstrations of the operation of the plant or of the effects of imposing various casualties. These plant evolutions and changes can be observed on a color display that depicts various "views" into the operation of the plant. These views include icons that depict valves, pumps, pipes, gauges, and other indicators. Using the system gives the instructor the advantages of being able to rapidly switch between different spaces, to quickly change the condition of the plant, and to repeatedly go through a plant evolution to allow students to observe the effects in different spaces. The STEAMER system has the ability to present dynamic graphical displays. These displays permit students to manipulate and observe representations of the system that resemble the model experts use to understand and reason about the operation of the plant.

The STEAMER project is a research effort concerned with evaluating the potential training applications of recent advances emerging from the new disciplines of artificial intelligence (AI) and cognitive science. While the project addresses a host of research issues ranging from how people understand complex dynamic systems to how AI software and hardware advances might be applied to training, it is focused around the construction of a computer-based system to assist in propulsion engineering instruction. The goal of this project is not only to build a training system with automated tutorial and explanation facilities, but also to construct a set of software tools that can assist in the implementation of future advanced training systems. The development of the STEAMER system and its software tools should provide the experience required to make principled decisions about the application of new AI and cognitive science technologies to Navy training problems.

grow and be modified by users of the system. The editor is one of the most exciting aspects of the STEAMER training system, since it not only allows the system to be continually updated and improved, but also can serve as an important software tool for the construction of STEAMER-like training systems in other domains.

In order to obtain feedback from potential users on STEAMER-like systems, STEAMER has been demonstrated at a number of sites (SWOS, Newport, Coronado, Great Lakes, and Shipboard Simulation School, New Orleans). The current research effort has two parts. The first is concerned with continuing the development of the intelligent tutorial aspects of STEAMER. This includes the development of a Lesson Editor and the development of facilities to enable diagrams to explain themselves to students as well as to pose problems and monitor students during their attempts to answer them. The second effort is concerned with the issues of transitioning the prototype system into operational use at SWOS, Coronado, and of identifying a more inexpensive and supportable delivery system configuration.

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The system is designed so that it can be easily extended and modified through the use of a Graphics Editor. The editor provides a mechanism for a subject-matter expert to construct views of the propulsion system and to tie those views to variables in the mathematical model so that the state of the system is dynamically reflected by the view. A user of the editor chooses components (e.g., dials, various types of pumps and valves, pipe, etc.) from a menu of available components and positions them by pointing to his choice of locations on the color screen. This makes it possible to construct a view of the plant that contains the necessary components to allow observation of a subsystem or aspects of different subsystems during the running of the model. The graphical editor allows the system to continue to

Report:

Hollan, J. D., Hutchins, E. L., McCandless, T. P., Rosenstein, M., & Weitzman, L. (1987). *Graphical interfaces for simulation. In W. B. Rouse (Ed.), Advances in man-machine systems research*, 3, 129-163. Greenwich, CT: JAI Press.

STEAMER: *An interactive inspectable simulation-based training system. AI Magazine*, 5(2), 15-27.

Hollan, J. D., Hutchins, E. L., & Weitzman, L. (1984). STEAMER: *An interactive inspectable simulation-based training system. In G. Kearsley (Ed.), Artificial intelligence and education*.

Electronic Countermeasures and Electronic Counter-countermeasures (ECM/ECCM) Training

computer authoring system, CBI Authoring Tools System (CATS), has recently been included to ease lesson authoring and revision.

The ECM jamming recognition lesson has been completed and implemented at FCTCP and FCTCL. This lesson teaches the student to recognize different types of radar jamming. Computer graphics, text, motion video of radar scopes showing the jamming, and audio narration are used. The lesson includes an introduction, a presentation of the subject matter, a review opportunity, a drill/practice with feedback, and an exam. Drill and exam scores are recorded by the jamming type and may be examined by the instructor at any time. Preliminary data gathering indicates that the students are enthusiastic about MPTS and seem to be better trained than previously.

Current project efforts include the use of CATS to develop a series of ECM lessons covering the application of "fixes" to each of the jamming types covered in the ECM jamming

recognition lesson. There will be a separate ECCM lesson for each of six radar types. The ECCM "fix" application lessons will all follow the same instruction, review, drill/practice, and exam process. Students will be required to identify jamming types and appropriate fix application(s) for the lesson radar type.

Plans for the next year include finishing ECCM lessons for six radars, development of a version of the lessons that will run on Zenith Z-248 computers with EGA graphics, and inclusion of CATS. These planned developments will allow instructors without special computer skills to originate and revise lessons. Other areas scheduled to be addressed in the future are the inclusion of additional hardware capabilities, determination of the requirements of remote-site and shipboard systems, and the development of a long range plan for implementation of MPTS with other microcomputer-based Navy training systems.

Reimbursable



The Fleet Combat Training Centers, Pacific and Atlantic (FCTCP and FCTCL), need ECM/ECCM training. Instead of using expensive simulators or fleet exercises to meet this need in the classroom, an ECM/ECCM microprocessor-based training system (MPTS) was developed to teach students how to recognize and counter radar jamming. This required selecting and configuring state-of-the-art computer equipment for training purposes and identifying and adopting a software support system capable of supporting ECM/ECCM hardware selected and delivered to FCTCL and FCTCP includes a Zenith Z-151 computer, Tecmar graphics board, Zenith 136 color monitor, Hitachi videodisk player, and video monitor. The software includes the MS-DOS operating system and a graphics editor. A Navy-developed



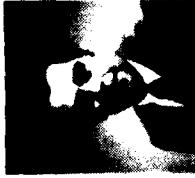
Principal Investigators:

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Intelligent Maintenance Training System

Principal Investigator:

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California. The bladefield system training course is currently using prototype generalized maintenance trainer/simulator (GMTS) technology, which was also developed by NRPDC. The GMTS is being used to supplement the hands-on diagnostic and troubleshooting portions of the bladefield system course. In its initial configuration, IMTS will act as a surrogate instructor for trainees using GMTS. It will monitor trainee performance and provide evaluative and directive feedback needed in the acquisition of system troubleshooting skills. NRPDC will evaluate the IMTS in the bladefield system application.

This project addresses several severe problems in current Navy technical training. Shortages of skilled personnel place a burden on the training establishment, as its instructors are removed to fill critical job needs in the fleet. The same pressures act on the availability of equipment for hands-on training. Increasing equipment costs tend to limit how much actual equipment can be procured for training purposes. The equipment that is available is often outdated and does not adequately prepare apprentice technicians to meet fleet job requirements. The use of general purpose simulators that can evaluate student progress and provide individualized coaching and performance feedback in a safe practice environment could shorten training time, as well as provide better qualified technicians to the fleet.

The objectives of this project are to provide technical and coordinating research support in connection with the development and acquisition of an intelligent maintenance training system (IMTS). The IMTS will initially be configured to provide exercise selection, sequencing, and tutoring for use in the SH-3 helicopter bladefield system training course at the Naval Aviation Maintenance Training Group Detachment, Naval Air Station, North Island,

a collaborative Navy/Air Force effort is currently underway to explore combined service applications.

Reports:

Malec, V. (in press). *Intelligent Maintenance Training System. In J. Paolka (Ed.), Intelligent tutoring systems: Lessons learned. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.*

Malec, V. (1987). *The generalized maintenance trainer: Evolution and revolution. In W. B. Rouse (Ed.), Advances in man-machine systems research, 3, 1-63. Greenwich, CT: JAI Press.*

The approach for this project has been to: (1) assist the Office of Naval Research in planning and preparing coordinating documentation, (2) participate in the contractor source selection, (3) monitor contractor progress, (4) act as an on-site coordinator, (5) develop test plans and data gathering tools for evaluating field performance, and (6) prepare plans for a second application test of the technology.

Project work began in FY84. In early FY85, the University of Southern California was awarded a 2-year contract to design, develop, and integrate IMTS with the GMTS hardware and software system. The design phase was completed in June of 1985 and the development phase is now nearing completion.

The FY88 effort involved completing the development phase, installing the system for initial testing, and conducting system evaluation in the bladefield system training course. Additional tasks will be to prepare IMTS for a second application using an electronic system to test the generalizability of the incorporated simulation and training editors.

A completed version of IMTS editors and system software has been delivered to the Air Force Human Resources Laboratory (AFHRL) and



Computer-based Performance Testing

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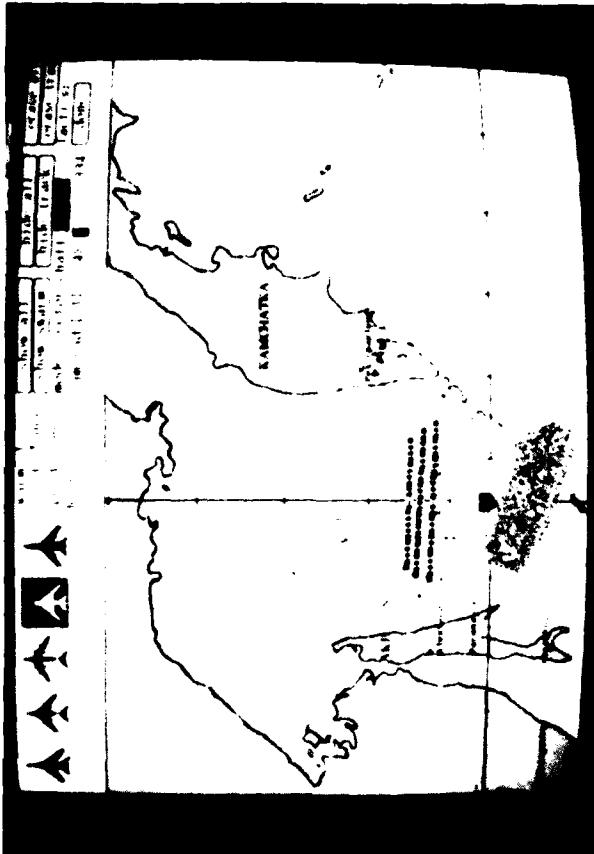
Accomplishments include the development of three generalizable and transferable computer-based performance-measurement systems. The first consists of a user friendly animated graphic simulation designed to assess how well individuals, teams, or crews can allocate, deploy, and manage tactical resources. The system simulates an outer air battle in which carrier-based task forces must be defended against incoming missile-launching Soviet bombers. Various warfare theaters are

simulated by the system yielding many different scenarios. This Battle Management Assessment System (BATMAN) automatically measures performance against 17 criteria. Results are provided to the individual at the end of each scenario.

A Raid Originator Bogue Ingress (ROBIN) was developed as a user friendly computer-based animated graphic simulation. ROBIN allows the creation of an infinite number of scenarios

ITypical procedures for assessing performance do not measure real-world operationally oriented tasks with sufficient fidelity, validity, and reliability. Consequently, student evaluation at its best is somewhat suspect, and decisions based upon this kind of assessment may be erroneous. Many of the customary methods for measuring performance either on the job or in the classroom are typically paper-and-pencil in nature (e.g., true-false, rating scale, multiple-choice formats). A number of deficiencies exist with these traditional testing techniques (e.g., biased items may be generated by different individuals). What is required is a technology for producing testing procedures that will correct these faults. Very few data are presently available regarding the psychometric properties of testing strategies using computer-based, graphically presented simulations or models.

The objective of this advanced development is to create and evaluate microcomputer-based graphic models of operationally-oriented tasks to determine if their use in testing results is a better assessment of student performance than customary measurement methods.



involving different numbers, types, formations, flight paths, and tactics of threat aircraft that are attacking a task force. BATMAN and ROBIN have capabilities that include the placing of chaff corridors, communications jamming, and launching and intercepting of anti-ship missiles. These systems can be readily adapted to generate scenarios and measure the performance of battle managers in many different warfare areas (e.g., antisubmarine and terrestrial environments, simultaneous subsurface, surface, and/or air warfare).

The second computer-based system was developed to assess or "recognize" performance (RECOG). The system measures how well individuals can identify aircraft silhouettes, human anatomy, electronic schemata, and topography. This was accomplished by keeping the graphic data base independent of the game management system. The system was programmed in a modular manner to instruct an individual on how to play the game, retrieve and display specific images, keep track of people's performance and provide them feedback, and link these components by supervising routines in order to execute the game. This modularity in programming structure contributes to the system's generalizability, providing a set of adaptable software tools for measuring recognition performance.

properties, attributes, or characteristics were represented as node-linked structures. Enhancements were programmed into two previously produced computerized quizzes, called FlashCards and Jeopardy, which are independent of the data base. However, the tests randomly select objects from the data base and generate questions about hostile platforms and their attributes. It must be emphasized that these tests, unlike most computer-based tests, have not been previously programmed. Improvements to these quizzes included (1) much-improved experimental control over these two computer-based games, (2) better record keeping for assessing student performance, facilitating the computation of statistical analyses, presenting feedback to instructors and students, and (3) capabilities to measure response.

These three computer-based systems were compared to respective traditional testing techniques to ascertain the systems' relative reliabilities and validities, and to establish whether these procedures significantly advance the state-of-the-art of performance assessment.

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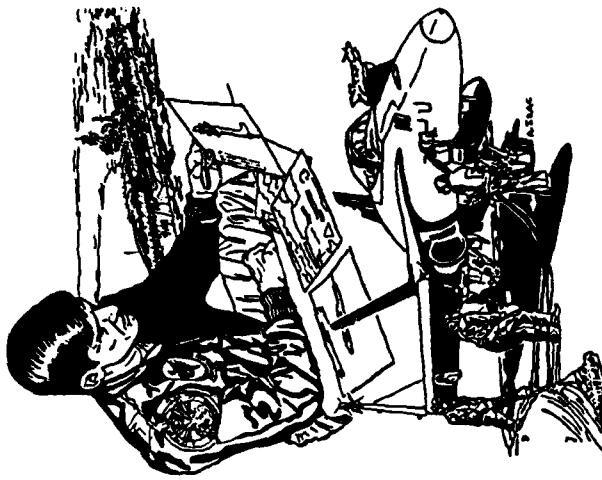
Reports:

Federico, P.A. (in press). Computer-based and paper-and-pencil measurement of recognition performance. San Diego: DOD/ETS Conference on Job Performance Measurement Technologies, San Diego, CA.

The third computer-based system was developed to assess semantic knowledge (e.g., associating threat parameters to hostile platforms (COMPUTHREAT). A classified data base was compiled. It was structured as a semantic network in order to represent the associative knowledge inherent to hostile platforms for the computer system. That is, objects and their corresponding

Federico, P.A., & Liggett, N.L. (1988). Comparing computer-based and paper-and-pencil assessment strategies for semantic knowledge. Paper presented at the meeting of the American Educational Research Association, New Orleans, LA.

Liggett, N.L., & Federico, P.A. (1987). Computer-based systems for assessing semantic knowledge: Enhancements. (NPRDC TN 87-4). San Diego: Navy Personnel Research and Development Center.



Federico, P.A. (1987, March). A microcomputer-based battle management assessment system. Paper presented at the DOD/ETS Conference on Job Performance Measurement Technologies, San Diego, CA.

Federico, P.A., & Liggett, N.L. (in press). Computer-based and paper-and-pencil measurement of semantic knowledge. San Diego: Navy Personnel Research and Development Center.

Chemical, Biological, and Radiological Defense Training

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A joint working group meeting with Pacific Fleet representatives was held in December 1987. At this meeting, researchers and operational Navy personnel exchanged information about CBR-D training and sharpened the focus of subsequent research efforts that will lead to 6.3 advanced development work.

Reports:

Robinson, C., & Van Kekerix, D. (in preparation). Chemical, biological, and radiological defense training: Development of working assumptions. San Diego: Navy Personnel Research and Development Center.

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Accomplishments to date include: (1) joint development of a research plan with NTSC, (2) an evaluation of existing schoolhouse CBR-D training, (3) development of a survey to assess fleet personnel's level of CBR-D knowledge and experience, (4) adoption by Commander, Training Command, Pacific (COMTRAPAC) of CBR-D knowledge and experience survey by spot testing of fleet personnel, (5) incorporation of CBR-D knowledge and experience survey into the evaluation plan for the newly developed Navy Disaster Preparedness Specialist Course at Ft. McClelland, (6) an evaluation of a low-cost intervention to enhance gas mask donning and doffing skills in recruit training, and (7) the identification of CBR-D degraded Navy tasks that will benefit most from training interventions and job aids sponsored by the Navy CBR-D Research Conference.

The threat of chemical warfare faces the Navy. The Chief of Naval Operations (CNO) has ordered the development of an effective Navy chemical biological radiological defense (CBR-D) capability. The best defense against chemical warfare is to wear a chemical-protective ensemble. However, this equipment could limit the capability of the protected personnel in the performance of critical combat tasks; thus, degrading or crippling assigned combat missions.

The objective of this research is to develop procedures to overcome or lessen performance degradation from a CBR-D environment, and examine the adequacy of existing CBR-D training courses. This effort is being conducted jointly with the Navy Training Systems Center (NTSC). The program is structured so that primary responsibilities for specific lines of research lie with each laboratory. This allows for a joint interchange of ideas and inputs toward the same program goals.

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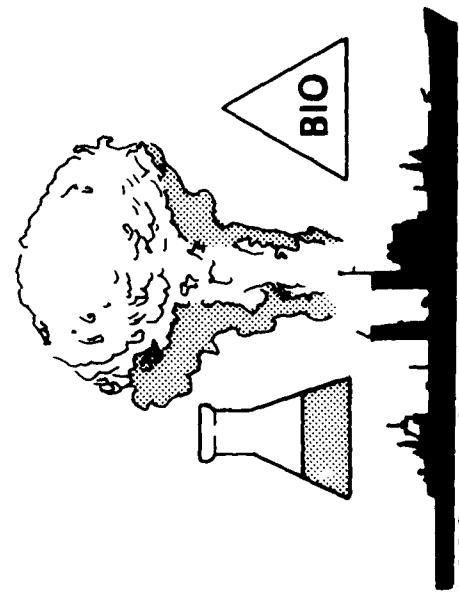
Future plans will explore and evaluate the use of various training interventions or job aids that may help to reduce the negative effects of a CBR-D environment on the Navy tasks identified earlier and begin development of procedures for use by Navy personnel to evaluate the impact on performance of wearing CBR-D protective garb.

P.E. 060233N

Robinson, C., & Van Kekerix, D. (in preparation). Chemical, biological, and radiological defense training: Training studies. San Diego: Navy Personnel Research and Development Center.

Van Kekerix, D., & Robinson, C. (in preparation). Chemical, biological, and radiological defense training: Knowledge and experience levels of fleet personnel. San Diego: Navy Personnel Research and Development Center.

Van Kekerix, D., & Robinson, C. (in preparation). Chemical, biological, and radiological defense training: Recruit Mark V gas mask training. San Diego: Navy Personnel Research and Development Center.



Joint Staff Officer Training System (JSOTS)

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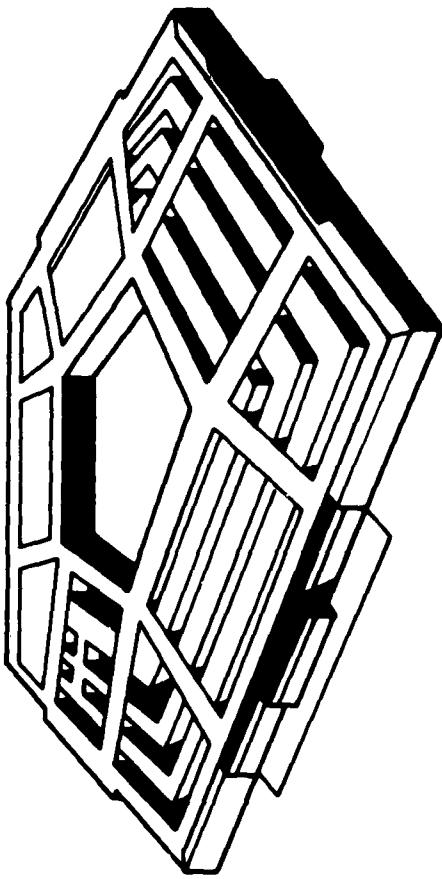
One research problem is how to plan a training program that will be accepted by the personnel for whom it is intended, given the conditions stated above. A second problem concerns the development of knowledge analysis methods that will be effective across the substantive areas, procedures, and organizational conditions of the Joint Staff. A third problem is how to select content that will be neither too specific nor too general to benefit the AO students.

Reimbursable

The Center is providing all instructional analysis, design, development, test, evaluation, and software support for JSOTS. Training will contain a wide variety of delivery options, including various forms of computer-assisted instruction, video tape and/or disk, group activities, written manuals, and seminar training.

The Center is developing a joint staff officer training system for the Joint Chiefs of Staff (JCS). The joint staff officer training system (JSOTS) will provide training to prepare newly assigned Joint Staff Action Officers (AOs) to quickly and competently assume their duties. These duties involve developing JCS positions and drafting JCS responses within assigned areas of responsibility. The actions are often wide ranging and may concern any aspect of defense planning and operations. They may have considerable economic, political, and diplomatic consequences, and are often extremely sensitive geopolitically.

The typical AO is a mid-career military officer (O4-O5) who currently must learn OJCS procedures on the job, sometimes after his or her predecessor has departed. The training system being developed will distill the wisdom of experienced AOs to assist a newly assigned AO in assimilating the tasks, procedures, and specialized knowledge of his billet. The training package will involve both a core curriculum for all AOs and specialized topics tailored to individual assignments.



E-2C Flight Officer System Training

The objective of the current effort is to conduct a Navy demonstration/evaluation CBI project. The vehicle for this demonstration is the APS-125 radar found in the E-2C Hawkeye aircraft. Training is being developed for this radar to demonstrate feasibility, acquire implementation experience, and evaluate authoring software. The APS-125 radar is a complex, computer-controlled system that requires extensive training for proper operation. This project is an attempt to demonstrate the feasibility of using readily available CBI technology to develop appropriate training and simulation materials for a number of facets of radar theory and operation.



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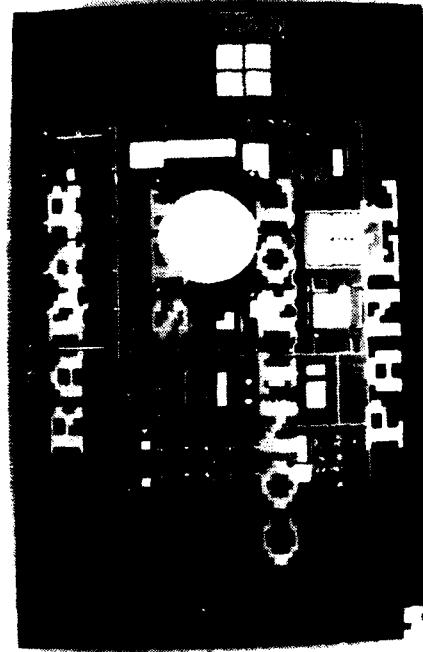
Prototype computer-based radar control lessons have been developed. These lessons simulate initial turn-on and test operating procedures that require extensive practice. They are designed so that non-programmers can modify the content. In addition, the CBI system uses commercial, off-the-shelf hardware that can easily be modified and maintained. This provides a low-cost, part-task training alternative to more costly simulators. The flexibility of this system allows for other types of training with the same hardware and software, thus lowering costs even more. To evaluate this, VAW-110 has an immediate need for extensive theory and nomenclature lessons. The low-cost CBI system will be used as a medium for these lessons, which make extensive use of graphics.

Working with subject-matter experts (SMEs) at VAW-110, the Pacific Fleet E-2C readiness squadron, objectives for basic radar theory and operator setup procedures were developed. These objectives were used to define the appropriate testing formats within the constraints of the CBI format. SMEs assisted in constructing theory and operation lessons in a workbook format. Other instructors and students have reviewed the operation lessons and workbook format.

The development and application of computer-based instruction (CBI) technology requires considerable planning. Training activities with requirements for CBI must address requirements analysis, budget justification, acquisition, and implementation to prevent several problems. Computers may be acquired before the instructional use has been determined.

Many Navy training activities are buying computers that are not compatible. Common software packages cannot be developed and shared without substantial recoding and duplication of effort. Many current CBI programs must be modified by programmers because they cannot be modified by instructors. This drives up the life cycle costs, which consist mainly of instructional development and maintenance. Some of these problems can be minimized by providing software that is standardized as much as possible, by carrying out logical instructional development procedures, and by providing a system that can be modified by instructors and educational specialists.

Stern, H. W., & McCabe, K. I. (1987). Reusing E-2C replacement naval flight officer training: Media and training issues and recommendations (NPRDC N 87-43). San Diego: Navy Personnel Research and Development Center.



Evaluation of a Low-cost Microprocessor-based Imagery Analysis Training Device

Principal Investigators:

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gram presentation. The microprocessor selected was the Zenith-150 and the Lofrogram simulation modeling software was the Passive Acoustic Display System (PADS) program developed at the Navy Weapons Systems Center. The general design of the project was to gather performance and attitude data first during the learning acquisition phase for students trained on either static paper Lofograms or on the Zenith-150 microprocessor. Then a measurement of how well those students retained that information 6 weeks after graduation from "A" School was obtained. This was done prior to any additional acoustic analysis training.

The skills and knowledge required to expertly analyze imagery has been recognized as difficult to acquire and even easier to forget. A substantial amount of work has been accomplished by this Center over the past 20 years in defining appropriate training objectives, systematic analytic methodologies, instructional delivery and testing strategies, and skill acquisition and maintenance requirements for imagery analysis operators in all four major Navy communities. It is natural, then, to be involved in evaluating the utility of microprocessor-based instruction to determine whether new technology can help shorten the acquisition process, lengthen the retention period, or influence the cognitive understanding of the underlying dynamics of a variety of complex image analysis tasks.

This project was initiated in the third quarter of FY86 in support of the Naval Air System Command (APC-205). The first computer-based imagery analysis task evaluated in this project was passive acoustic analysis. The Aviation Anti-Submarine Warfare Operator (AW) "A" School was in the process of converting their acoustic training environment from the traditional, static, paper Lofrogram practice laboratories to microprocessors capable of delivering dynamic

instructional staff as well as student and instructor attitudes about the two different modes of instruction.

An additional tasking for this project is to determine whether there are any notable long term effects on students' performance in the follow-on technical pipeline. Data will be obtained concerning performance scores, setbacks, attrition, or other important student behaviors to determine whether modes of instruction effect student performance differentially throughout their acoustic training. Recommendations will be developed that will guide further implementation of microprocessor-based imagery analysis training in the technical pipeline and in squadron training programs.

Reimbursable

Report:

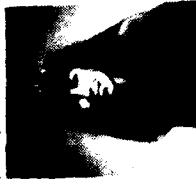
Wetzel-Smith, S. K., Richards, G., Forgnoni, R. L., & Czech, C. (in press). *Evaluation of a low-cost microprocessor-based acoustic analysis training center*. San Diego: Navy Personnel Research and Development Center.

The second area of microprocessor-based training evaluated in this project was Inverse Synthetic Aperture Radar (ISAR) imagery. This is a new analysis task of concern to radar operators in a number of aviation platforms. This analysis began in the first quarter of FY88 and is being conducted as the Air Antisubmarine Radar Squadron Twenty-Seven (VS-27) Fleet Replacement Squadron, NAS Cecil Field. A Zenith-248 microprocessor training system supports ISAR schoolhouse training requirements throughout the technical pipeline and in the fleet squadron training program. The quality of this training is being evaluated for potential use in pre-course preparation and in post-course skill retention. There are several questions that this project will answer. Two of those questions may be of most importance to the present AW training pipeline and to other technical schools considering the cost effectiveness of computer-based instruction. The first question concerns whether students learn more/better/differently when instructional materials are delivered on a computer-based system rather than the traditional paper-and-pencil course. The second question is whether students trained in a computer-based environment retain more of the critical skills and knowledge determined to be very important to success in the follow-on technical schools. Other questions of interest include the ease of course conversion, materials development, and teaching practices for the

Requirements Assessment for S-3B Sensor Training

Principal Investigators:

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existing acoustic training be modified and new training be developed entirely for analyzing Inverse Synthetic Aperture Radar (ISAR) imagery. Additional changes to the electronic warfare systems also required changes to the analysis and operational configuration training in existing courseware.

Work on this project was initiated during the second quarter of FY86. Phase I efforts were focused in individual sensor operator training requirements with an emphasis on the cognitive aspects of analysis and interpretation. Four major sensor systems included in the S-3 WSIP update were analyzed in-depth. The operator requirements for analyzing and interpreting system derived data were analyzed in terms of system components and operating characteristics, important mission factors, and requisite knowledge domains, parametric data bases, and analysis strategies.

The Navy depends upon the operational skills of technical personnel to perform complex tasks to support mission requirements. State-of-the-art, computer-based weapon systems provide defensive and offensive capability against a wide range of sophisticated enemy threat. The real value of these systems, however, depends upon how well they can be used by the personnel tasked to operate them. Operators must be able to analyze and interpret a variety of images and digitized displays appearing on these systems under combat stress conditions. These operators must be able to provide accurate and timely information needed to ensure good tactical decisions. The quality of those decisions will make the difference between mission completion and mission failure.

This project is directed toward developing training for the sensor crew in the S-3B aircraft. This aircraft is an updated version of the S-3A and includes the S-3 Weapon Systems Improvement Program (WSIP) that introduces new sensors such as the AN/UYU-1 acoustic processor, the AN/APS 137 profile radar, the AN/ALR-76 Electronic Surveillance Measures (ESM) systems, and the AN/ALE-39 Electronic Counter-Measures (ECM) system. An analysis of information processing requirements was performed for each of the four new WSIP systems. The inclusion of these sensors required that

computer-based ship recognition training that is based on a systematic process of feature analysis. This training has been specifically developed to support ISAR analysis throughout the technical training pipeline and into fleet squadron training programs. Courseware and computer-based feature analysis training will be made available to other platforms and to assist in ISAR and ship recognition training requirements.

Reimbursable

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Reimbursable

Wetzel-Smith, S. K., & Forgnoni, R. L. (in press). *S-3B Crew training requirements* (U). San Diego: Navy Personnel Research and Development Center.

Reports:

Wetzel-Smith, S. K., Forgnoni, R. L., & Couven, M. (1987). *Critical mission and knowledge factors for S-3B sensor analysis training* (U). San Diego: Navy Personnel Research and Development Center.

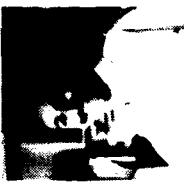
Phase II, initiated in first quarter FY87, was concerned with crew coordination and task loading issues. Mission scenarios were developed and validated by experienced S-3 crew members (pilot, co-pilot, tactical officer, sensor operator). These scenarios provided a valid operational context to determine a number of important crew performance factors such as task distribution, communication requirements, and potential task over-load points. Results of these analyses provided guidance in the development of crew-based training objectives, weapon system trainer scenario development, and proficiency testing strategies.

An addition to the original project tasking resulted from the Phase I report documenting the high level of cognitive understanding required for successful interpretation of ISAR imagery. FY88 tasks include technical assistance in the on-going ISAR training development effort at Naval Air Station (NAS), Cecil Field. NPRDC will assist Navy and Navy contractor personnel in implementing the organizational schema defined by research analysis of ISAR imagery training requirements. Additionally, NRPDC will develop

Interactive Video Instructional Development for the H-53E

Principal Investigator:

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advanced interactive video authoring system.

The new interactive video lessons will be developed using the following approach: H-53 maintenance tasks that are appropriate for interactive video instruction will be identified.

The authoring system being developed by NRPDC will be rehosted on the H-53 training system.

Subject-matter and instructional design expertise will be obtained to develop and implement new interactive video training modules in accordance with approved Navy and Marine Corps instructional development practices. This will include the development and/or applications of lesson-specific terminal and enabling objectives. This will also include the construction of lesson outlines, scripts, story boards, and other instructional design aids to ensure content

validity, appropriate media applications, and effective instructional sequencing. Lesson capabilities will include: (1) the presentation of audiovisual representations and/or graphic representations of helicopter systems, panels, switches, indicators, and related components that constitute the subject-matter for individual lessons; (2) the presentation of audio and/or visual descriptions of systems and component functional capabilities, operating procedures, safety precautions, and other related skills and knowledge associated with job/task performance; (3) the ability for trainees to interact with individual system representations, and the corresponding ability to give the appearance of normal consequences for those actions (e.g., altering system states, repositioning of system switches and control, etc.); (4) the ability to describe and cause trainees to follow prescribed steps of procedure in guided exercise and test formats; (5) the ability to accurately portray normal and abnormal indications of systems operations; and (6) the ability to monitor and track student performance (e.g., scores, exits, time) within a lesson module and to provide descriptive and directive feedback with regard to task

performance. Individual lesson modules will afford capabilities such as adaptive and serial branching, moving forward or backward through lesson content, "help" features to assist in understanding lesson content, videographic overlay, and testing for knowledge and skills acquisition.

During FY88, H-53 maintenance tasks have been identified and training system hardware specified, procured and installed, and H-53 training system drivers have been developed and added to the Center's CATS authoring system. H-53 lesson development has begun and data is being collected on the use of CATS in an interactive video environment.

Reimbursable

The objective of this project is to design, develop, implement, and test new interactive video lessons at the training sites using NRPDC's

Troubleshooting Proficiency Evaluation Program (TPEP)

Principal Investigator:

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hardware preclude the use of drill and practice exercises. This limits the technician's ability to maintain his troubleshooting skills and restricts maintenance or improvement of his abilities.

The objective of the TPEP is to support the operational Navy (both active duty and reserve) and the training communities, and within the hardware systems selected, to provide capability for (1) assessment of personnel troubleshooting capabilities within the Navy training environment (e.g., "C" school and/or reserve training activities), (2) drill and practice of personnel under training who are awaiting hardware availability or active duty assignments, (3) improvement of curricula and training methods based on feedback of school troubleshooting assessment results, (4) fleet and reserve on-board-training (OBT) through drill and practice exercises, (5) assessment of fleet and reserve personnel troubleshooting capabilities, (6) an objective measure of operational readiness of fleet and reserve personnel in the area of systems hardware troubleshooting capability, (7) improvement of operational readiness, and (8) improvement of curricula and instructional methods as a result of objective operational fleet and reserve feedback of assessment/evaluation data to the training community.

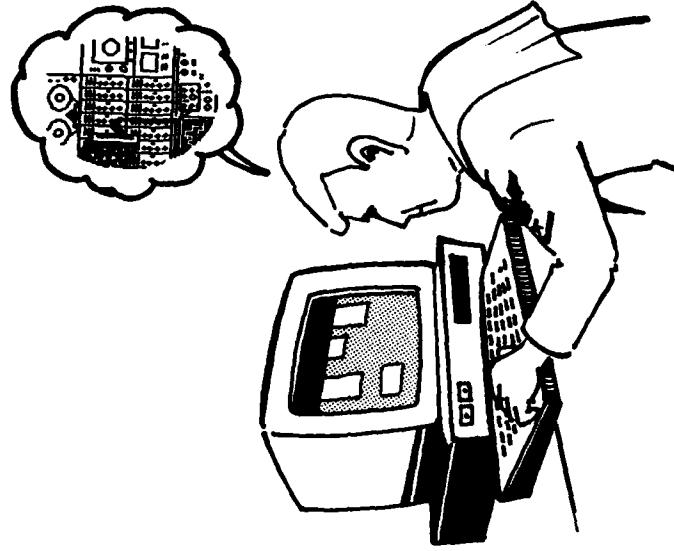
Currently the Navy has no means of objectively measuring the troubleshooting proficiency of the shipboard technician and his ability to contribute to operational readiness. Other than subjective supervisory opinion, there is no way to assess the transfer of training, particularly hands-on, in the Navy "C" schools. Once the "C" school graduate has been integrated into the ship's force, fleet commanders have no objective method to assess the technician's performance capabilities or skill degradation over time. In addition, the schools receive no quantifiable feedback identifying specific areas where troubleshooting training requires greater emphasis or improvement.

Because of the limited availability of system hardware at the "C" schools, actual hands-on training time is severely restricted. This minimizes the amount of time students can use their system knowledge, and therefore decreases the effectiveness of instructional programs. Once on-board, the ship safety hazards associated with corrective maintenance of weapon system

of the model. Finally, a report will be generated that will address the training sites and results as they apply to the TPEP and as feedback to the schools for course modification and improvement. There will also be an effort to develop a troubleshooting episode authoring system (TEAS).

As of FY88, the selection of system hardware, software, and architecture was 90 percent complete. Computers and networking hardware were ordered for the training sites and an extensive literature review was undertaken. Project documentation is continuing.

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The approach will be to (1) determine hardware systems and test sites, (2) develop operational procedures at the test sites, (3) define TPEP technology, (4) develop applications methodology, (5) select TPEP demonstration device/technique, (6) select troubleshooting tasks, (7) evaluate troubleshooting tasks for scenario development, and (8) develop troubleshooting scenarios. A troubleshooting factors model will then be developed, and using data results from the various test sites, be compared across and within sites to ensure accuracy and improvement.

Training Resources Management

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this work, the Center is developing a historic file of Navy training policies and changes to the policies from 1979 to present. The file will be organized by year, subject, and organization and will be based on all training instructions and directives issued from different levels, including OP-01, CNET, and schoolhouses. When TRAINTRACK data are examined in conjunction with information from the Policy File, the Navy will be able to see the past effects of its actions and use the insight as a guide to future policies.

To improve the Navy's ability to relate training costs to fleet readiness, the Training

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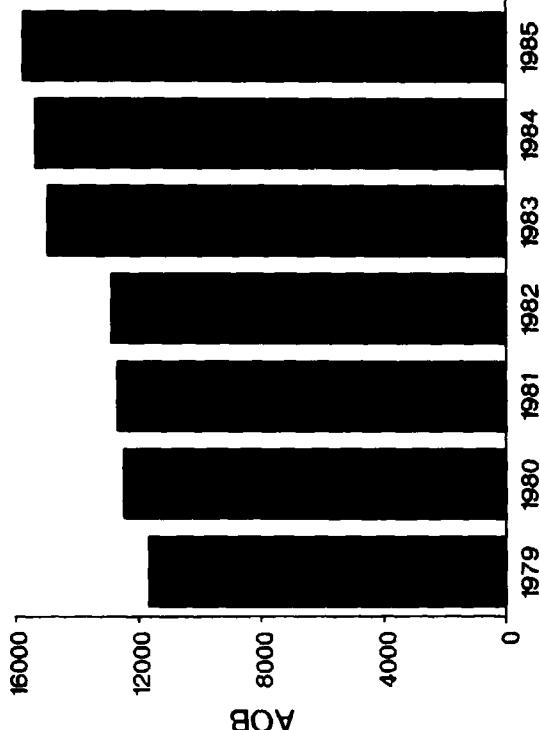
Resource Management project is constructing models for training planners. The first model is a "C" school fiscal year development plan (FYDP) model. The core of the model is an expert system of the current "C" school planning process. Planned "C" school Navy Enlisted Classification (NEC) output over the FYDP is balanced against training resource constraints. Future enhancements will allow users to analyze different "what if" scenarios. This will lead to an efficient allocation of scarce training resources.

Relating the costs of Navy training to fleet readiness currently involves a mixture of models and manual calculations. The calculations are complicated by inexact data on fleet requirements in the out-years, by volatile inventories because skills degrade over time, by conflicting objectives, and by imprecise fixed and variable costs. It is very difficult for planners to calculate the effects of alternative training plans and to defend training costs.

The Training Resource Management project began by developing a historic longitudinal data base of individual training episodes from 1979 to the present. This Enlisted Training Tracking File (TRAINTRACK) merges data from the Student Master File, the Survival Tracking File, CNET cost files, and the Support Program for Incentive, Retention, and Training (SPIRIT) data base. The merged data are organized by Social Security Numbers so that an individual's entire training can be examined. Currently, TRAINTRACK is being used to obtain de facto "C" school pipelines, and to examine possible causes for setbacks and attrition from training.

TRAINTRACK will also be used to study the effects of changes in Navy training policies. To do

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Career Systems Design (CSYD)



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continua development methodology, conducting a 10-week workshop for fleet Subject-Matter Expert (SME) inputs, developing the rating training continuum, producing a Continuum Training Plan (CTP), conducting a fleet review of the CTP, providing assistance for CTP implementation, evaluating the CTP, and revising the CTP where necessary.

The OS rating training continuum development effort is being directed by an Executive Committee (EXCOM) composed of Captain-level membership representing manpower, personnel, and training; the warfare sponsor, and OS rating training continuum users.

In 1983, the Navy Inspector General (NAVINSGEN) conducted a review of the Chief of Naval Education and Training (CNET). The NAVINSGEN findings indicated that there was no cohesive training plan across an individual's Navy career. The Navy Training Strategy, published in 1985, directed that a training continua approach be used for development of training. NPMDC was tasked to utilize the training continua approach to develop a methodology for Navy enlisted personnel training. The purpose of the CSYD project is to provide a rating continua training design methodology using the Operations Specialist (OS) rating as the design vehicle.

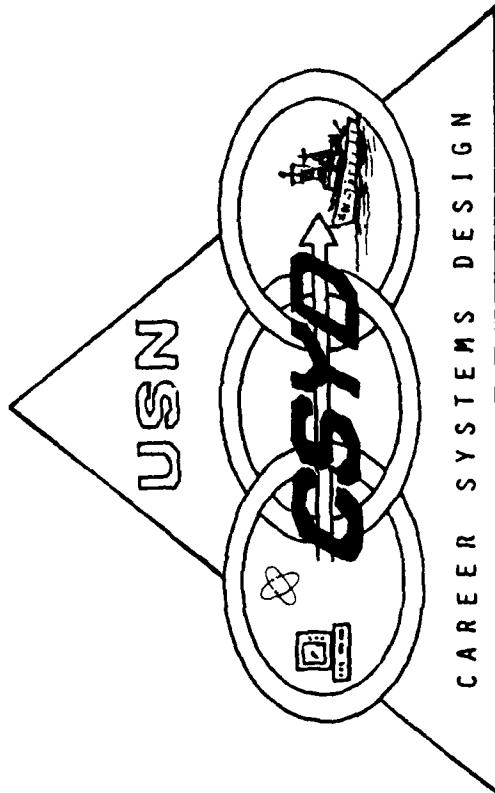
A rating training continuum is defined as a training path with all skill and knowledge requirements for a designated rating, which identifies the appropriate career points for administration of that training. It extends from the completion of recruit training through all potential rating-related billets and includes both formal classroom and on-board training.

The CSYD approach includes the following components: specifying the rating training continua definition, devising the rating training

process model, a data integration model, a rating training continuum development workbook, a workshop coordinator's guide, workshop guidelines, a rating continuum technology base, OS policy issue papers, OS technical data modules; (2) an OS rating training continuum, which includes PPs and TPSs; (3) an OSCTP, a rating training continuum implementation plan, and a rating training continuum evaluation plan.

Potential benefits of the CSYD effort are: provide a cohesive and comprehensive approach for training across a person's career; promote interaction and communication between Navy management, training communities, and the fleet; and realize cost savings through efficient and effective training and enhanced professional development.

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USMC Individual Training Standards

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revise ITS Development Guides to support the contractual development of TSAR and ITS/MPS, and (3) prepare, award, and monitor contracts to develop TSAR, ITS for MOS designated by HQMC and MPS.

The systems approach-to-training (SAT) techniques, as specified in Marine Corps references, will be applied to the development of TSAR and ITS/MPS. Emphasis will be on the elaboration of the analysis phase of SAT. An ITS Development Guide for this process has been developed and will be verified through the contractual process.

The Training Department, Headquarters, Marine Corps (HQMC), has the responsibility for developing Training Situation Analysis Reports (TSAR) and Individual Training Standards (ITS)/Mission Performance Standards (MPS). However, the Marine Corps itself lacks the personnel capable of developing the systems for all areas. The TSAR will assist in making decisions on training issues of current military occupational specialty (MOS) structures. ITS will be used to provide guidance for MOS training. ITS must be developed for each category of individual training conducted in Marine Corps units and institutions. MPS will be used to provide guidance for unit training. The TSAR and ITS/MPS will contribute to the design, development, implementation, and evaluation of all individual and unit training programs. The ITS/MPS will be available for instructional institutions and unit commanders as well as for individual Marines. This will ensure that all Marines who have the same job are taught the same critical skills and knowledge required to perform the job as individuals or as a unit, in order to accomplish the doctrinal mission.

The objectives of this project are to (1) develop TSAR and ITS/MPS in support of the Training Department, HQMC, (2) develop and

In FY87, TSAR and ITS were completed for 55 military occupational specialties within the Marine Corps. An ITS Development Guide was made available in March 1987, and was used by contractors as a reference for designing a Job Aids document. An ITS Historical Data Package has been developed under contract, and is serving as an audit trail for incoming HQMC personnel assigned to ITS development. This is also serving as the basis for revisions to the ITS Development Guide. The ITS program will continue with the development of ITS for 121 additional MOS and 4 MPS efforts.

Reimbursable (O&M, MC)



Infantry Map Interpretation and Terrain Association Course (MITAC)

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when these terrain features are portrayed on maps. The third part teaches a terrain association strategy for finding a location on a map. Applying this strategy systematically eliminates map areas that do not match the real world scene resulting in a limited number of potential candidate map areas for the location. Using the SOSES procedure and map design guidelines on the potential candidate areas eliminates all but the actual location.

The Infantry MITAC uses a dual 35mm slide system with a taped narrative to deliver the

interactive training. The instructional materials include numerous skill building exercises.

Results of an evaluation of the MITAC program at the Division Schools, Camp Pendleton, First Marine Division, showed that Marines' ability to correlate the real world and the map improved significantly. The MITAC program was implemented in May of 1988 at The Basic School (TBS), U.S. Marine Corps, Quantico, VA.

Reimbursable (O&M, MC)



Marine Corps infantry personnel use land navigation skills to plan and carry out their missions over a variety of terrains. An analysis of the land navigation task revealed that traditional classroom methods adequately teach map and compass skills. However, instruction in map and terrain association skills is limited, and lacks procedures and appropriate training aids for identifying terrain characteristics.

As a result of this analysis, NPRODC was tasked to develop training to improve the map and terrain association skills of Marine Corps infantrymen. The training developed, called the Map Interpretation and Terrain Association Course (MITAC), consists of three parts. The first teaches procedures to evaluate mapped and real world landforms in terms of shape, orientation, size, elevation, and slope. The term "SOSES" (pronounced SOSs) is a mnemonic devised to assist infantrymen to remember each step in the landform assessment and identification process. The second part teaches the interpretation of water, vegetation, and man-made features based

Marine Corps Training

Training Support for U.S. Marine Corps (USMC) Project. A Marine Corps requirement exists to support all phases of the five-phase Marine Corps Systems Approach to Training (SAT) process. The Individual Training Standards (ITS) contract, currently in place, is restricted to only the front end of the five phases. Because of this, the Marine Corps requested NPRDC to establish a Training Support Indefinite Quantity Contract (IQC) to include all aspects of the SAT. The purpose of the contract is to provide support in the areas of training system analysis, design, development, evaluation, standards development, ADP development control and management, and cost benefits analysis to meet USMC requirements. This effort is currently going through the contractual process and will be awarded in FY89.

The Training and Education Branch of the Marine Corps Combat Development Command does not have the personnel available to complete the number of efforts currently required, and has requested support from NPRDC on a number of efforts.

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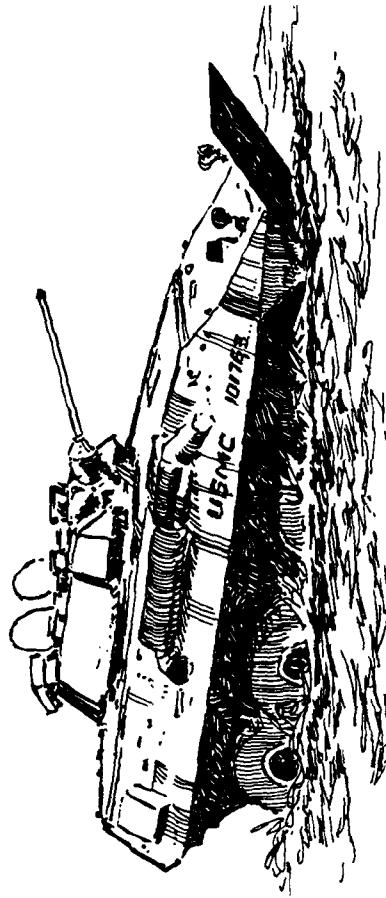
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Marine Corps Systems Approach to Training (SAT) process. The Individual Training Standards (ITS) contract, currently in place, is restricted to only the front end of the five phases. Because of this, the Marine Corps requested NPRDC to establish a Training Support Indefinite Quantity Contract (IQC) to include all aspects of the SAT. The purpose of the contract is to provide support in the areas of training system analysis, design, development, evaluation, standards development, ADP development control and management, and cost benefits analysis to meet USMC requirements. This effort is currently going through the contractual process and will be awarded in FY89.

Reimbursable (O&M, MC)

Light Armored Vehicle (LAV) Requirements Analysis Project. The School of Infantry (SOI), Camp Pendleton is the sole institution in the Marine Corps that *instructs* Marines on the LAVs. Presently, only a Basic Crewman Course for the LAV-25 is available. The SOI was tasked by the training code of the Commandant of the Marine Corps (CMC(T)) to begin development of additional courses for the LAV. There is an immediate need for Officer and Staff Non-Commissioned Officer (SNCO) courses. Specific subject areas include supervisory maintenance, driving, and gunnery training. The purpose of this effort is to conduct an analysis to determine specific course requirements and compare existing instruction to determine if there is any overlap. This effort will be completed in FY89.

Reimbursable (O&M, MC)



Instructional Management Schools

Curriculum Development Project. New Marine Corps orders have brought about changes in the procedures and documentation requirements at Marine Corps formal schools. In order to facilitate a smooth transition from the old to the new procedures and provide standardized courseware in the Instructional Management Course and the Formal School Instructor Course, courseware revision was required. The objective of this effort is to conduct an analysis of the existing courseware and subsequently develop revisions. NRPDC is the instructional designer and is monitoring the development contract, ensuring the quality of the instructional curricula. This effort began in FY88 and will continue through FY89.

Biopsychometric Assessment for Performance Monitoring

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with more information than he can handle. This condition, known as cognitive overload, is associated with impaired decision making, which increases the likelihood of human error. Combat systems also have the potential for inducing boredom and inattention in the operator by assuming too much of the workload. This condition, known as cognitive underload, is associated with decreased vigilance, which impairs the ability of the operator to detect and respond to critical events. In addition to the threat of inappropriate workload, the cognitive state of an individual human operator will vary as a result of metabolic and psychological factors that are not stable over time. For these reasons, it is necessary to identify and exploit all possible means of enhancing the performance of combat system operators. Scientific and technological developments in the area of biopsychometric assessment may prove useful in enhancing the performance of human operators of computerized systems. Specifically, biopsychometric assessment methods provide information about the state of the operator that can be used to optimize cognitive workload and predict performance decrements due to varying metabolic and psychological factors.

For several years, NPPRDC has been investigating the use of biopsychometric measures (e.g., event related potential (ERP) and the neuromagnetic evoked field (EF)) to improve the prediction of performance in Navy and Marine Corps personnel. Earlier research efforts using passive ERP and EF recording procedures have demonstrated significant results in the assessment of human performance. These studies indicate the potential usefulness of biopsychometric methods in the assessment of personnel.

This project addresses the need for minimizing human error in military command, control, and communication systems. The accelerated worldwide development of technology makes it mandatory that the Navy keep abreast of developments that may pose unexpected threats or provide unanticipated opportunities. One such threat is posed by the proliferation of complex ship- and air-borne weapons and defensive systems (combat systems). Evidence mounts which indicates that in the performance of combat-related cognitive tasks, such as detection and tracking by radar operators, performance is variable in quality and generally below standards. These performance problems are due in part to the ability of combat systems to present the operator

related to performance. Subjects who performed well generally had lower variability than subjects who performed poorly. Together, these findings indicate that performance of tasks such as AIRDEF is inversely related to distractability, which was assessed off-line by analyses of probe EPs. AIRDEF-based probe amplitude measures were related to an overall rating of on-job performance in the same subjects. Direction of the relationships was identical to those found for AIRDEF performance.

Second, an earlier observation (FY87) of a relationship between AIRDEF workload and the amplitude of potentials evoked by irrelevant visual probe stimuli was confirmed by across-study validation. Specifically, the group average for irrelevant visual EPs decreased significantly between baseline and active engagements of AIRDEF, as predicted by resource allocation models. However, this work failed to show differences between group averages of probe EP amplitudes at two high levels of AIRDEF workload.

Third, it was found that the internal structure of evoked potentials produced by auditory secondary task-related probe stimuli was significantly related to AIRDEF workload. Two major sources of variance in the probe-evoked potentials, N1 and P3, were related to selective attention and higher cognitive processing. Using the technique of analysis of covariance to separate these sources, investigators found that P3 amplitude was related to AIRDEF workload both between baseline and active engagements and between different high-load engagements.

In FY89, work on this project will be coordinated and integrated with related work at the Naval Health Research Center and the Naval Aerospace Medical Research Laboratory. The emphasis at NPPRDC will be on the development of methods for real-time signal processing of EPs and on decomposition of complex tasks, such as

AIRDEF, in order to better understand the relationship of EP measures to cognitive processing. Signal processing issues include data screening, ocular artifact handling, and improvement of signal-to-noise ratio. Task decomposition issues include EP correlates of signal detection, short-term memory, speed and distance estimation, decision-making, and risk management.

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Reports:

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Marine Corps Biopsychometric Assessment

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are obtained by using contact electrodes, as during EEG recording. Neuromagnetic recording has many advantages, including the utilization of noncontact electrodes and the ability to improve the localization/accuracy of recording.

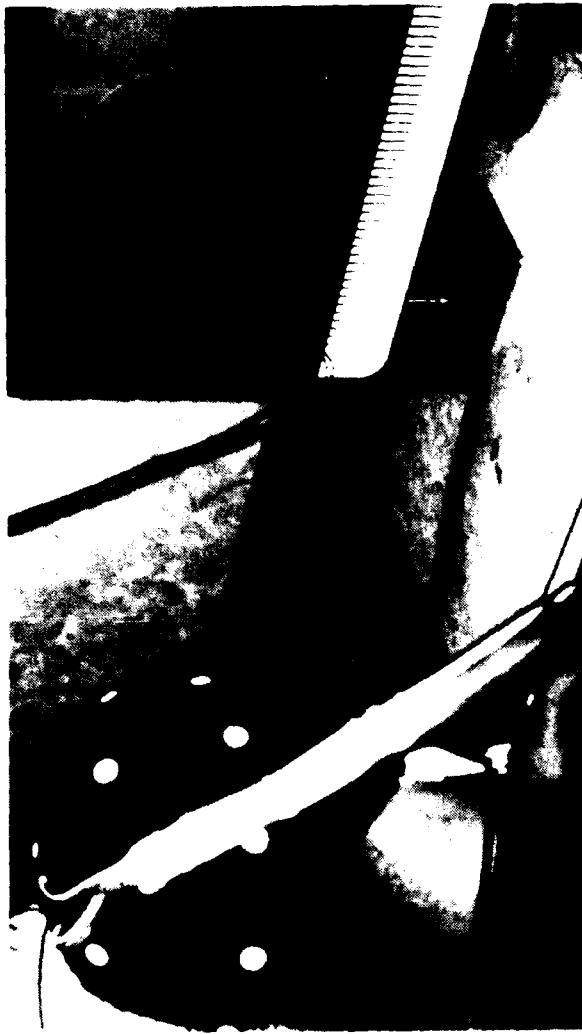
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The objective of this research is to determine the feasibility of using biopsychometric measures to improve Marine Corps personnel performance prediction under baseline, fatigue, and stressful conditions, and to improve fitness-for-duty, and, possibly, selection and classification.

Traditional personnel assessment procedures have depended heavily on paper and-pencil tests, which are able to predict school and training performance, but not on-the-job performance. The introduction of computer adaptive testing (CAT) based on item-response theory and adaptive testing algorithms has allowed more precise measurement of personnel at all ability levels. CAT also may be unable to adequately predict on-the-job performance, as it, still depends heavily on behavioral response to context-based questions, inferences of brain processing, and cannot measure underlying processes. New testing procedures are needed to supplement the information from these tests by directly assessing brain and muscle information to more accurately predict performance under baseline, fatigue, and stress conditions.

NPRDC biopsychometric predictor data will be analyzed, in FY89, with the JPM predictor and criteria data obtained by the Center for Naval Analysis.

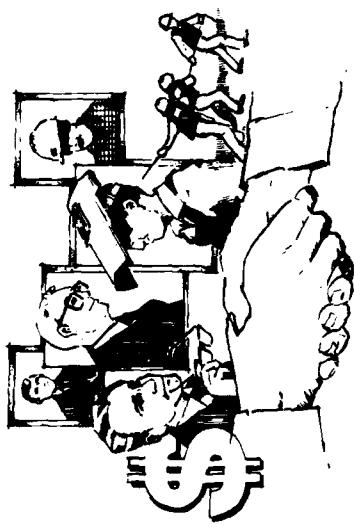
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Lewis, G. W., Trejo, L. J., Nunez, P., Weinberg, H., & Naoh, P. (1987). Evoked neuromagnetic fields: Implications for indexing performance. Presented at the 6th International Conference on Biomagnetism, Tokyo, Japan.



This Center has found research emphasizing "process" rather than "content" information to have promise for improving the prediction of operator on-job performance. Such research uses neuroelectric and neuromagnetic recordings. Advances in the understanding of brain processes have provided procedures to more accurately measure individual differences and capabilities than

Applications of Organizational Systems

Logistics



Organizational Systems Function and Product Line Descriptions

Develops and evaluates methods and systems for improving the effectiveness, quality, and productivity of Navy personnel and organizations.

Logistics--Determines requirements, designs, tests, and evaluates management methods and techniques appropriate for quality and productivity improvement in Navy logistics organizations. Research efforts are focused primarily on measurement-based approaches to systems analysis, process and performance measurement, and application of organizational theory. Techniques currently under development include Productivity Gain-Sharing (PGS), Total Quality Management (TQM), organization redesign technology, and program evaluation of experimental personnel policy changes.

Acquisition--Determines requirements, designs, tests, and evaluates management methods and techniques appropriate for quality and productivity improvement in Navy acquisition organizations. Also, develops and tests innovative methods to design, administer, and evaluate management and professional training. In addition, job aids are developed and tested to determine their effects on workload accomplishment.

Experimental Civilian Personnel Office (EXPO) Evaluation

restructuring of personnel action processing (e.g., use of automated procedures). The changes, if successful, will result in new civilian personnel policy in many areas.

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target groups). During Year 2, the major focus of the evaluation has been on assessing the direct effect of the changes on CPO functioning (intermediate outcomes) and on determining whether the changes have resulted in any unplanned or unintended outcomes. In the third and final year of Project EXPO, emphasis will be placed on determining the ultimate effects of the EXPO changes and their overall success or failure. Consideration will be made of the appropriateness of the changes for other organizations within the Federal government.

NPRDC, in cooperation with the EXPO sites, is conducting an evaluation to determine the success of the changes. Project EXPO will cover a 3-year implementation and test period. The changes proposed by the participating sites and an evaluation plan developed by NPRDC were submitted to the Office of Personnel Management (OPM) for approval. OPM identified the proposed changes that could be implemented, granted waivers of regulations governing those changes, and approved the overall evaluation plan.

During the course of the project, NPRDC is assisting internal evaluators at each site in developing individual assessment plans; overseeing the collection, analysis, and integration of selected data that describe the progress of Project EXPO; and is assessing the overall EXPO effort. Assessment findings are routinely reported to the EXPO Planning Committee and the sites by both internal and external evaluators. The EXPO participants meet semiannually.

Reimbursable (DoD, HQ)

During the first year of Project EXPO, attention was centered on obtaining measures of the local sites (the CPOs' ability and willingness to effect the proposed changes), implementing activities (the degree of implementation support and actual degree of implementation), baseline measures for intermediate outcomes (the impact of the projection CPO processes), and ultimate outcomes (the impact of the project on significant

The purpose of this effort is to support the research and evaluation needs of selected Department of Defense (DoD) civilian personnel offices (CPOs) during their participation in the EXPO project. Project EXPO was developed in response to identification of recurring difficulties in civilian personnel departments' abilities to respond to constituent needs (e.g., lack of timeliness in fulfilling traditional staffing functions, lack of flexibility in dealing with position management problems).

Under Project EXPO, 13 CPOs, representing the Air Force, Army, Defense Logistics Agency, and Navy and under the coordination of representatives from the Office of the Deputy Assistant Secretary of Defense, are making changes in their personnel functions in an effort to improve efficiency and effectiveness. The changes being tested by the various sites range from modifications in personnel management (e.g., delegation of classification authority) to



Implementing Productivity Gainsharing in Navy Organizations

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(S&L), has established a goal to have 10 PGS plans operational in Navy organizations by the end of 1988. NRPDC has been tasked to assist ASN (S&L) SPECAG in reaching this goal.

Our efforts are coordinated through a multi-task project. The tasks and deliverables are described below.

Task I: Pre-Implementation Training and Assessment. Our first task was to assist in PGS training for the pilot sites and conduct an assessment of the readiness to implement PGS of 17 nominated pilot sites. This assessment gauged the degree to which the environment and organizational conditions are favorable for adopting PGS. More importantly, it identified what actions are necessary to ensure the highest probability of success in implementing PGS at each pilot site. The assessment covered issues such as: (1) capability to improve and work availability, (2) management readiness to adopt a PGS philosophy, (3) capacity of the measurement system to easily make PGS calculations, and (4) employee and union readiness to accept a PGS philosophy. Based on this assessment, recommendations for action were prepared for each of the sites and SPECAG, identifying those things that they should do to increase their chances of success in implementing PGS.

On 25 February 1986, President Reagan issued Executive Order 12552, which required all Federal agencies and departments to improve productivity at least 20 percent by 1992.

In response to this order, Navy productivity improvement plans call for accelerated implementation of productivity gainsharing (PGS) at Navy activities and installations.

PGS is a group-based financial bonus and employee involvement system. It is designed to improve productivity and performance through better use of resources (people, capital, materials, and energy). Gains resulting from improved productivity are shared with the employees, the organization, and customers according to a predetermined formula.

As a first step in accomplishing the Navy's plan, the Specification Control Advocate General (SPECAG) in the Office of the Assistant Secretary of the Navy (ASN), Shipbuilding and Logistics

formula, (3) helping the design team develop the system to support existing productivity programs (e.g. Total Quality Management) and ensure employee involvement, and (4) assisting the design team in developing a system for tracking productivity improvement and employee involvement.

Task III: System Implementation

Assistance. For our third task, we will assist the four extensive assistance sites in implementing and adjusting the designed system. This involves: (1) assisting the sites in getting the PGS system operating, (2) helping each site develop the training materials they will use to introduce the PGS system and its employee involvement module for improving productivity, (3) helping to introduce the system and training the workforce in system philosophy and operation, and (4) reviewing the on-going operation of the PGS system and providing troubleshooting support to the organizations. We will recommend adjustments to the system as necessary to correct any emerging problems.

Task IV: Program Evaluation. For our fourth task, we are developing an evaluation plan and an evaluation data base and retrieval system for all of the sites attempting to implement PGS. The data base system will store a broad spectrum of evaluation criteria and program characteristics.

By developing a data base system for storage and retrieval of this data, ASN (S&L) SPECAG and others will be able to quickly summarize the results of the implementation of PGS. Perhaps even more valuable will be the ability of the system to examine the effects of various site characteristics or combinations of characteristics on the effectiveness PGS. This will be extremely useful in making recommendations to sites seeking to adopt PGS in the future.

Reimbursable

Defining Management's Responsibilities for Total Quality

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improvement represent a few of the responsibilities required by TQM. Managers need to understand this new role and their responsibilities in the TQM process improvement model.

The objective of this project is to develop a management workshop that will provide the training necessary for managers to use the TQM process improvement model components for their specific organizations and to identify individual roles and responsibilities for TQM process improvement.

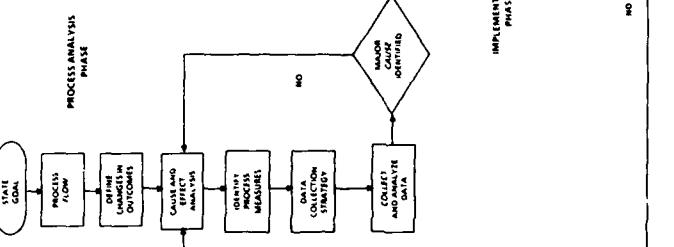
In an effort to improve quality and productivity, naval maintenance and repair is attempting to use a management approach known as Total Quality Management (TQM). TQM is based on a set of management practices and statistical methods that are combined to remove the causes of poor quality and to reduce costs.

Under the TQM approach, managers are expected to fulfill their responsibility for quality improvement through the interpretation of process data and use of a systematic problem-solving approach. The approach is based upon Shewhart's Plan-Do-Check-Act cycle. Until recently, the major tasks of the cycle have not been clearly explained for management. A model was designed to outline the major tasks involved in improving quality through TQM.

The implementation of TQM by Navy managers requires them to adopt practices and responsibilities that they have had little, if any, experience in applying in actual operations. Increased interdepartmental cooperation, participative management, empirical analysis, and long-term commitment to process

In FY87, the first phase of developing training materials and workshop review was conducted with representatives from the Naval Aviation Depot community. Funding provided by Naval Supply Center, San Diego, and Naval Aviation Depots (NAVDEPs), North Island and Alameda, was used to develop a Process Improvement Model (PIM). This PIM provided managers with a step-by-step method of identifying process problems, implementing changes, and maintaining performance gains. A process improvement effort involving disassembly of the F-14 was documented as a case study at the North Island facility. The Center also developed a set of tutorials to educate managers in the concepts of TQM.

TQM PROCESS IMPROVEMENT MODEL



As an adjunct to the TQM program, a Total Quality Audit project was undertaken at the NAVDEPs to teach managers how to develop quality audit procedures to evaluate the implementation of TQM.

The TQM program is continuing in FY89.

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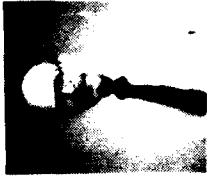
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Guidelines for Transportable Education and Training (GTET)

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performed by NPRDC to explore the feasibility of developing transportable versions of the BDAC. The results were very positive as indicated by the responses of senior officials in program management. This led to the start in FY87 of the current 6.4 Joint Services funded effort, titled "Guidelines for Transportable Education and Training" (GTET). The goal of the GTET effort is to provide guidelines that will make it easier to develop cost-effective transportable education. These guidelines are based on the Instructional Systems Development (ISD) process and are tailored for application to non-technical education and training programs, particularly for non-resident programs. The guidelines are also being designed for use by training decision makers or managers who might be relatively unsophisticated in the ISD process.

The Defense Systems Management College's (DSMC) Basics of Defense Acquisition Course (BDAC) is the 6-week basic, or introductory component of the 20-week Program Managers' Course (PMC). The demand for BDAC has increased significantly in recent times due to the increased pressure for improvement in the acquisition system and the resulting legislative requirements that more people receive this training. DSMC does not have the facilities nor the personnel to accommodate this increased demand. Moreover, reduced budgets throughout the government have limited potential for students of BDAC because the resident course at DSMC requires their attendance for an extended period of time, which is very expensive. Advances in instructional technologies, particularly in the use of computer-based instructional development and presentation, offer ways to present non-resident alternatives as potential solutions to the problem. These technologies offer the opportunity for students to take a course at, or near their job site(s), with minimal requirement for interaction with an instructor or a course manager.

The Naval Air Systems Command provided funding in FY86 for a small pilot project

systematic approach of GTET will reduce the amount of time required for the modification/updating of course material. (3) The provision of transportable materials equivalent to resident courses will significantly reduce travel and per diem costs. (4) Through having the course material available at a job-site, selected lessons can be tied in more closely to job and training requirements to make training more efficient and effective. The material will also be available for review or refresher training at any time. (5) There will be a significant reduction in the number of hours needed for the students to complete the course materials. (6) An increase of trained personnel will result in significantly less job/performance errors.

Beyond BDAC, there are a number of additional courses at DSMC for which these guidelines could be applied. In addition, they can be applied to courses that exist at similar educational or training agencies such as the Air Force's Institute of Technology, the Air Force Systems Command's System Acquisition School, and the Naval Air and Sea Systems Commands' Executive Institutes and the Navy's Consolidated Civilian Personnel Offices. All of these agencies are members of the GTET project coordination/working group.

DSMC is planning ways of applying the GTET techniques to the remaining four modules of BDAC so that an entire transportable version of BDAC will be available in the near future.

A key component of the 6.4 effort will be the development and application of a cost-benefit/cost-effectiveness model. It is hoped that this model and the lessons-learned data will make subsequent efforts more efficient and effective. Cost effectiveness will be realized in several areas due to the implementation and use of the GTET: (1) The application of advanced technologies through use of the GTET is expected to reduce course development time significantly. (2) The

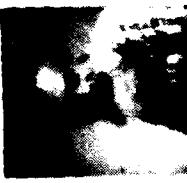


Reimbursable (ARI)

Low Cost Computer-based Briefing and Training Presentations for Naval Air Systems Command

Principal Investigator:

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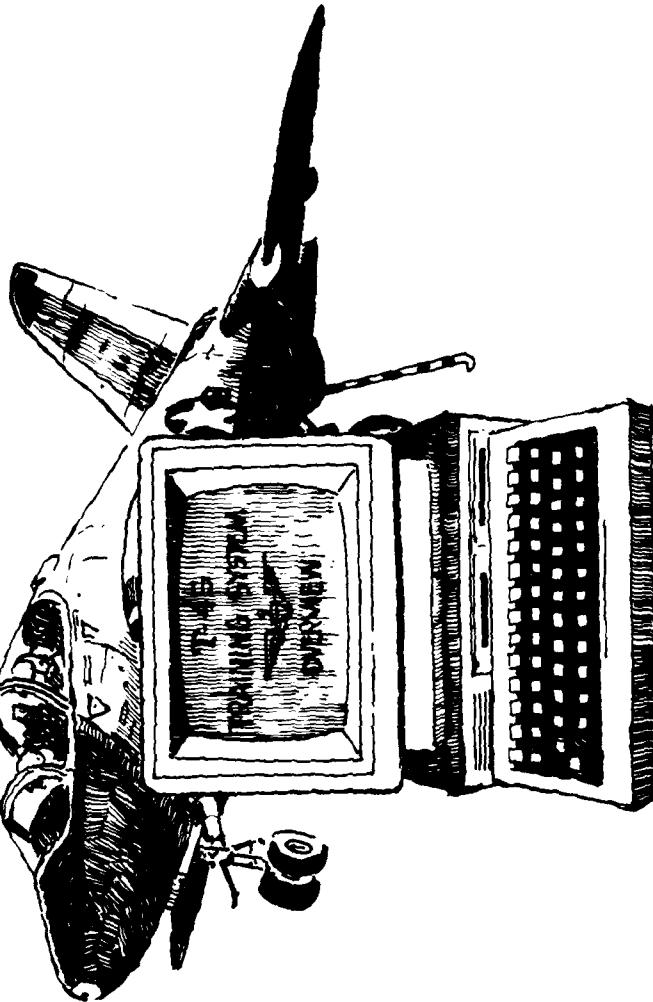
initial knowledge levels on the topic. Expected payoffs include: (1) labor savings on training/briefing presentation, (2) lesson/briefings available on-demand reducing scheduling problems, (3) standardized presentations, and (4) foundation for a computer-based instruction system that could be expanded in the future to provide for in-house training.

Two computer-based lessons were developed in conjunction with the T-45 Training System Office for use by program personnel. Hardware

was purchased and installed in the program office. One "briefing" on the T-45 system is in place and being used. Another, more generic lesson on program, planning, and budgeting system (PPBS) was completed and installed in December 1988.

Additional lessons are scheduled for completion. Some of these lessons are relatively generic to many NAVAIR program offices and, once evaluated, may be installed in other offices.

Reimbursable



The Naval Air Systems Command (NAVAIR) is faced with two problems common to the other Systems Commands (SYSCOMs). One is having to present repetitive briefings to a wide variety of people. The other is providing short-term training on a number of generic topics for personnel who frequently shift in and out of the program offices. Many of the offices provide a large number of presentations, which are labor intensive. Some alternative method of presentation is needed.

There is a need for training and briefings that can be readily transportable between program offices and SYSCOMs. They must be dynamic in presentation and modifiable by program personnel. To meet these needs, microcomputers available under the Air Force/Navy contract can be used to present experimental lessons and briefings. Because the lessons are computer-based, individuals may view them on demand, thereby decreasing senior program staff involvement and providing standardized information and training. The resulting computer-based briefings and lessons are designed for people with a wide variety of

Total Quality Management Education for the Department of Defense

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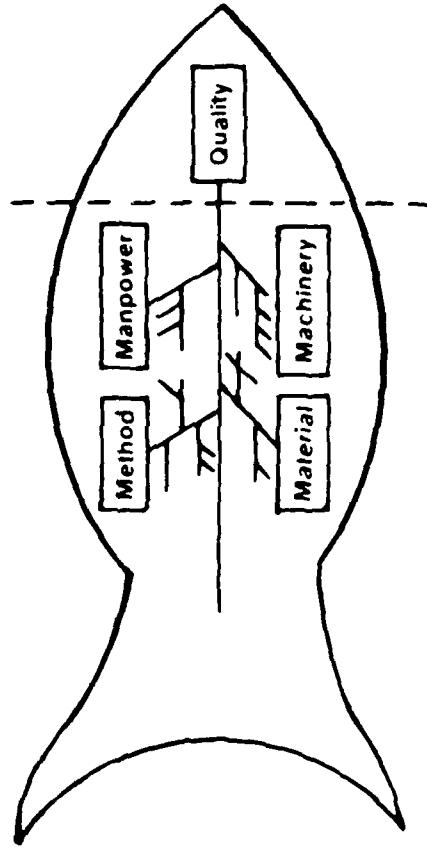


The TQM/DoD project has three thrusts. The first is to develop a plan for educating the acquisition workforce in TQM, which will be integrated into the Master Plan. The second thrust involves developing the objectives and outline of a curriculum for a senior management course in TQM. This information will be used in both the educational plan and in the development of a senior orientation program. The third thrust was to assist with conducting the DoD Deming Seminar, which was held in Washington, DC in late May 1988.

Follow-on efforts in FY89 will include designing a TQM Resource Center for the DoD and investigating optional methods of educating, training, and implementing TQM for senior managers.

Reimbursable

The Department of Defense (DoD) has begun a major thrust to improve the quality and productivity of products purchased and services provided by DoD. The approach selected to achieve this objective is Total Quality Management (TQM), a management philosophy of long-term commitment to constant improvement of products and services. Essential to achieving this goal is the development of a comprehensive education and training program to successfully implement and maintain TQM. As part of this effort, DoD is formalizing a TQM Master Plan, which will include a strategy for education of the acquisition workforce in TQM. Efforts have also begun to educate the most senior managers in the DoD. NPDFC is developing the education strategy and is contributing to the educational programs for senior managers.



Appendix A
NPRDC On-site Research Applications

Project	Application	Site
Manpower Systems		
Advancement Interface System (ADIN)	Petty Officer Advancement Planning	OP-135C, Navy Annex
Force Analysis Simulation Technique (FAST)	Enlisted Inventory Projection	OP-135D, Navy Annex
Management Decision Simulator (IMAGE)	Manpower Management Training Simulator	DASD (Manpower), Pentagon; USMC Headquarters, Arlington Annex; OP-01/NMPC, Arlington Annex
Structured Accession Planning System for Officers (STRAP-O)	Officer Manpower Analyses	OP-130
Officer Personnel Information System (OPIS)	Officer Information Delivery System (IDS)	OP-130; OP-136
Budget Obligation Analysis & Tracking System (BOATS)	Manpower Budget Management	NMPC-7, Washington, DC; NMPC, Cleveland, OH
Defense Personnel Analysis Systems (DPAS)	Defense Personnel IDS	OASD (FM&P)
Enlisted Personnel Allocation & Nomination System (EPANS)	Enlisted Personnel Assignment	EPMAC, New Orleans; NMPC, Washington, DC
Officer Distribution Management System (ODMIS)	Officer Distribution	NMPC; CINCPACFLT; CINCLANTFLT; CNET

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PROJECT PROFILES: SEAPOWER THROUGH PEOPLE(U) NAVY
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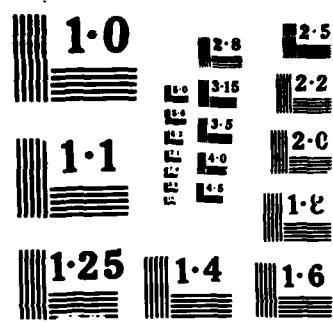
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Appendix A
NPRDC On-site Research Applications (Continued)

Project	Application	Site
<u>Personnel Systems</u>		
Classification & Assignment Within PRIDE (CLASp)	Maintain/Evaluate Classification & Assignment System	NMPC-48
Personnel Distribution & Career Development (PDCD)	Determine Factors Leading to Pilot Retention	OP-136; OP-130E; OP-59
	Evaluate Equal Opportunity (EO) among Unrestricted Line Officers (URLs)	OP-01 EO Task Force
	Evaluate NAVOP-105 policy	OP-130E; OP-39
	Evaluate Aviation Duty Officer (ADO) Program	OP-130E; OP-59
	Evaluate Materiel Professional (MP) Program	OP-130E
Officer Selection Systems	Develop JSPEC Policy	OP-130E
	Maintain/Evaluate Selection System	U.S. Naval Academy

Appendix A
NPRDC On-site Research Applications (Continued)

<u>Project</u>	<u>Application</u>	<u>Site</u>
Testing Systems		
Computerized Adaptive Testing (CAT-ASVAB)	Data Collection for Score Equating Development	Military Entrance Processing Stations & satellite Mobile Examining Team Sites (San Diego, Richmond, Seattle, Boston, Omaha, Jackson)
Education and Training		
Career Systems Design	Rating Continua Design Methodology	OP-113
USMC Individual Training Standards	Development of Training Standards for over 100 MOSs	HQ USMC/MCCDC, Quantico USMC Squadrons
Helo Map Interpretation & Terrain Association Course (MITAC)	Improvement of Pilot Navigation Skills	MAWTS 1; MCAS, Yuma
Fixed Wing MITAC	Improved Map Interpretation Skills for Fixed-wing Pilots	Combat Division Schools (Camps Lejeune & Pendleton)
Infantry MITAC	Improved Map Interpretation for USMC Ground Combat Personnel	NAMTRAGRU, North Island
Intelligent Maintenance Training System STEAMER	Training of SH-3H, AE & AD Maintenance Personnel	Surface Warfare Officers School, Coronado
	Training Aid in Teaching Operation of 1200 lb Propulsion System	

Appendix A
NPRDC On-site Research Applications (Continued)

Project	Application	Site
Electronic Countermeasures & Electronic Counter- countermeasures (ECM/ECCM)	Teaching Recognition of & Response to Electronic Radar System	FCTCPAC; FCTCLANT
S-3B Features Recognition Systems (FADS)	Training of Personnel to Recognize Contacts on Advanced Radar System	VS-27
S-3B Passive Acoustic Decision System	Training of Advanced Acoustic Decision System	VS-27; VS-41; VP-30; VP-31; ASWTRACENPAC/LANT
E-2C	Training of Tactical Personnel in Operation of Radar System	VFW-110; VFW-120
H-53	Computer Training System for USMC H-53 Maintenance Personnel	MCAS, El Toro
Batman & Robin	Tactical Action Officer & Tactical Warfare Overview Courses	FCTCP
	Carrier Airborne Early Warning Weapons School	NAS, Miramar
	Marine Aviation & Weapons Tactics Squadron One, Commanders & Instructors Weapons & Tactics Courses	MCAS, Yuma
	Wargaming Laboratory	PostGraduate School
	Applied Physics Laboratory Warfare Analysis Laboratory	Johns Hopkins University

Appendix A
NPRDC On-site Research Applications (Continued)

Project	Application	Site
Schoolhouse Productivity	EM "A" School	NTC, Great Lakes
Low Cost Micro-computer Training Systems (CBESS)	Officer & Specialist Threat Recognition Training	Navy & Marine Corps Intelligence Center, Dam Neck
	Tactical Action Officer Threat Recognition Training	FCTCP, San Diego
	Helicopter Crew Threat Recognition Training	Aviation R&D Facility, Ft. Rucker
	Remedial Training (JOBS)	CNTECHTRA
	Remedial Training (SeaBees)	Naval Construction Training Center, Gulfport
	EM "A" School	NTC, Great Lakes
Authoring Instructional Materials (AIM)	70 Weeks of Instruction in Various Fields	NETSCPAC, Training Systems Development Department
	Over 500 Weeks of Instruction in Engineering & Electrical Systems	NTC, Great Lakes Service School Command
	Submarine Systems	Naval Submarine School, New London
	Trident Engineering, Operations, & Strategic Weapons Training Materials	TRIDENT Training Facility, Kings Bay & Bangor
	NAVSEA Curricula	Naval Ship Weapons System Engineering Station, Philadelphia & Port Hueneme

Appendix A
NPRDC On-site Research Applications (Continued)

Project	Application	Site
AIM (continued)		
Artificial Intelligence (AI) Tools in Authoring	SSN-21 Systems Computerized Front-end Analysis Tools	Newport News Shipbuilding NETSCPAC, Training Systems
	Computerized Front-end Analysis Tools	NTC, Great Lakes, Service School Command
	School Planning; Attrition Control; Analysis of Non-productive Time	NETPMSA; CNET; OP-112
Training Resources Management (TRAINTRACK)		
Joint Staff Officer Training System	Training on Joint Staff Operations	Joint Chiefs of Staff, Pentagon
AI in Explosive Ordnance Disposal	Computerized Job Aids	EOD Technology Center, Indian Head, MD
Courseware Portability	Programming Standards for CBI/Video	Office of the Secretary of Defense, Pentagon
Organizational Systems		
Guidelines for Transportable Education & Training (GETET)	Transportable Basics of Defense Acquisition Course (BDAC) Materials Prototype	Defense Systems Management College (DSMC)
Experimental Civilian Personnel Office (EXPO)	Evaluating Innovative, Civilian, Personnel Practices	CECOM, Ft. Monmouth; NSC, Norfolk; USAF Academy; Def. Ind Supply Cir, Philadelphia, USAEUR NAF, Heidelberg, Stuttgart, Frankfurt; Defense Depot, Memphis;

Appendix A
NPRDC On-site Research Applications (Continued)

Project	Application	Site
Expo (continued)		
Organizational Survey	Develop & Administer Survey	Defense Contracting Administration Services Region (DCASR), Cleveland; Sembach AFB; Patrick AFB; Davis Monthan AFB
NAVAIR Total Quality Management (TQM)	TQM Prototype	Navy Regional Contracting Center (NRCC), San Diego
DCASR TQM	TQM Prototype	NAVAIR-04
TQM for Office of the Secretary of Defense (OSD)	TQM Educational Design	Defense Contracting Administration Services Region (DCASR), Philadelphia
DCA TQM	TQM Prototype	OSD, USD(A)
Navy Logistics Productivity Quality Improvement	TQM Prototype	Defense Communications Agency (DCA)
	TQM Assessment	Naval Aviation Depot (NADEP), North Island & Cherry Point; Sacramento Army Depot
		Pearl Harbor & Portsmouth Naval Shipyards
Productivity Gain Sharing (PGS)	Gain Sharing System	Naval Surface Warfare Center; Naval Avionics Center; Public Works Center, San Diego; Naval Supply Center, Oakland
Acquisition Technology	Technology Enhancements in Program Management Offices	NAVAIR (PMA-273; PMA-260)

Appendix B
NPRDC Data Bases

Data Base	Description	Sponsor/User
<u>Manpower Systems</u>		
Defense Planning Programming Category (DPPC) Models	DPPC models forecast manpower based on historical workload data	OP-12G
MPT Assessment Subsystem	Requirements & authorization by DPPC sponsor, program element, claimant, skill, paygrade	OP-12G
MAPRO	Ships, aircraft, & manpower (historical)	OP-12G
FAIM	Historical enlisted Navy personnel data	OP-135
Enlisted Personnel Planning System (EPPS)	Historical & projected Navy enlisted personnel data	OP-130
FAIM-O	Historical longitudinal Navy officer personnel data	OP-130
Officer Personnel Information System (OPIS)	Historical, aggregated Navy officer personnel data	OP-130
USMC Enlisted Personnel Data Base	Historical, longitudinal USMC enlisted personnel data	MPP-20
USMC Officer Personnel Data Base	Historical, longitudinal USMC officer personnel data	MMP-30
QMA Data Base	Qualified military available projections for USMC recruiting regions	USMC

Appendix B
NPRDC Data Bases (Continued)

Data Base	Description	Sponsor/User
Defense Personnel Analysis System (DPAS)	All-service historical & projected officer & enlisted personnel data	OSD (Manpower) NMPC-7
BOATS	Navy military personnel entitlements data	
Personnel Systems		CNET (N-1A)
NRORC	Applicant information, school performance information, fitrep data	NMPC-48
CLASP	Accession data, job options presented by CLASP	USNA (Dean of Admissions)
Naval Academy	Applicant information, school performance information, fitrep data	OP-130E
Officer Career	Questionnaire information, Officer master file information	OP-135L/ NMPC-48
Defense Manpower Data Center (DMDC) ASVAB Data^a	Navy applicants & accessions by FY used for validation & related studies & analyses	

* Data bases are extracted from larger data bases for use in responding to consumer's requests for data analysis.
^a Data bases are extracted from larger data bases for use in responding to consumer's requests for data analysis.

Appendix B

NPRDC Data Bases (Continued)

Data Base	Description	Sponsor/User
Reading Grade Level	Examinee data on both ASVAB & reading grade tests, used to estimate reading ability of military accessions without administering a reading test	DoD, Force Management & Personnel (FMP)
Navy Integrated & Training System (NITRAS) Data^a	Navy class "A" school information merged with ASVAB data & used for ASVAB validation & related studies & analyses	OP-135L/ NMPC-48
Computer Managed Instruction (CMI) Data^a	Similar to NITRAS data, merged with ASVAB data & used for ASVAB validation & related studies & analyses	OP-135L/ NMPC-48
Personalized Recruiting for Immediate & Delayed Enlistment (PRIDE) Data^a	Recruitment information (date of enlistment, targeted rating) from automated classification system (CLASP), used for studies on Navy recruits & creating regression formulas used in CLASP	OP-135L/ NMPC-48
American Youth Population (AYP) Data	1980 metric sample for ASVAB (youth 18-23), maintained, used for calibrating new forms of ASVAB, developing population parameters needed for correcting for restriction of range in ASVAB validation samples	OP-135L/ NMPC-48

^a Data bases are extracted from larger data bases for use in responding to consumer's requests for data analysis.

Appendix B
NPRDC Data Bases (Continued)

Data Base	Description	Sponsor/User
<u>Education and Training</u>		
TRAINTRACK	Maintain operating Navy schoolhouse training data, down to the individual student level, permits look at training effectiveness/costs	OP-11 & CNET- NETPMSA
TRAINTRACK-R	Same type of data as above, maintained for Naval Reserve	Training Performance & Data Center

No attempt is made to provide a complete listing of documentation. Other publications designed to inform military and civilian agencies about the Center are available upon request.

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